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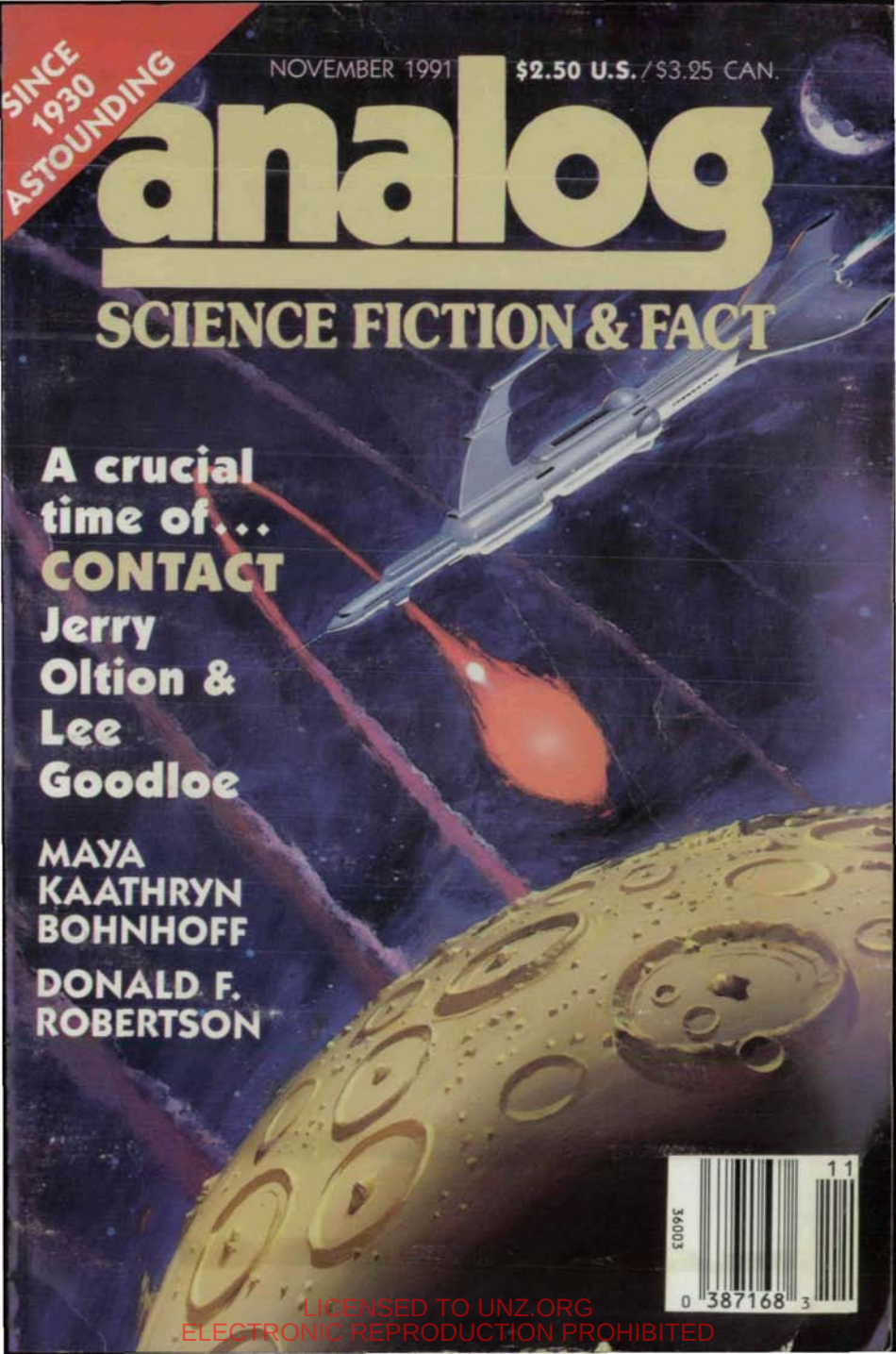

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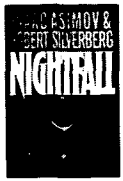

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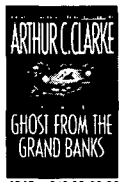

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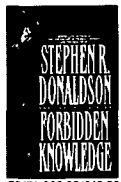

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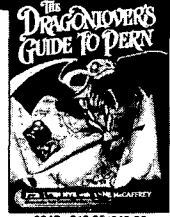

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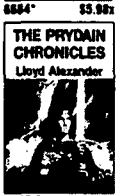

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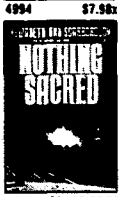

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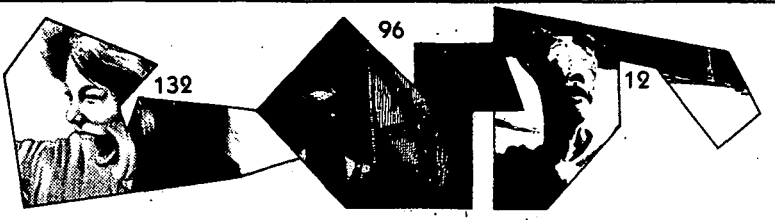

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Editorial

MASS

Stanley Schmidt

There are enough pitfalls in reasoning by analogy that whenever one is tempted to do so, it's a healthy practice to start the process by reminding oneself to watch out for them. However, the pitfalls are not so ubiquitous that one should avoid the temptation to consider analogies No Matter What. Indeed, there are situations in which analogies, if scrutinized carefully, can be so precise that they make more laborious methods quite unnecessary.

If you look at the basic physics of an electrical circuit containing an inductor and a capacitor, for example, you quickly get a differential equation that looks *exactly* like that for a simple mechanical oscillator consisting of a mass on a spring. Only the names of the variables have changed: the inductor plays the role of "mass," the capacitor "acts like" a spring, and so on. If you've already solved the equation for the mass-on-a-spring case, there's no need to repeat the mathematical toil for the electrical analog. You just take any of the equations you derived for the mass on a spring, replace each of the variables by its counterpart for the electrical cases, and you get a new equation that you can be quite confident accurately describes the corresponding behavior for the circuit.

Sometimes an analogy isn't quite that simple or rigorous, but can still be useful. "Mass," for example, is an extremely important, very generalizable concept that can be applied to thinking about quite a wide range of things. In its most basic form, it's a concept from Newtonian mechanics which can be thought of as quantity of matter, quantity of "gravity-producing stuff," or resistance to acceleration. (It's quite a remarkable fact, which profoundly baffles physicists when they get down to thinking about things at a really fundamental level, that those all seem to be equivalent—but that's another story.)

The aspect of mass I ask you to contemplate today is the last: resistance to

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acceleration. You first heard of this back in grade school (I hope) as Newton's first and second laws of motion: that a body at rest tends to remain at rest and a body in motion tends to remain in motion in a straight line at constant speed unless acted on by an outside force, and that any change in velocity is in the direction of and proportional in magnitude to the applied force. Later, if you stuck around long enough, you learned that these were really just one law, that rate of change of (vector) momentum is proportional to the applied force. (The "first law" is just the "second law" with zero force.)

If things move fast enough, "momentum" gets to be a bit tricky because "mass" can change as well as velocity. But at low speeds, where the Newtonian model is good enough for almost all practical purposes, mass can be treated as a simple proportionality constant characteristic of an object. If you want to make a 1,000 kg object move in a certain way, you have to apply a million times as much force as to produce the same motion as a 1 gm object. The basic, qualitative idea is that it's a lot harder to change the state of motion of a massive object than that of one with very little mass.

"State of motion" as used here is quite precisely defined, but anyone who's lived long in the world will recognize at once that there are many other things in everyday experience which behave in "sort of the same way." Just as it's harder to deflect a charging elephant than a pestering gnat, so is it harder to *cook* the elephant, should you want to do such a thing. You need apply very little heat to raise a gnat's temperature to a lethal level. The same amount of heat *might* be noticed as a very trivial annoyance by the elephant, if it happened not to have anything more interesting on its mind at the moment. Does this imply that there is also a "thermal mass" characteristic? If so, is it the same as the "inertial mass" of Newtonian mechanics?

Well, yes and no. It does take twice as much heat to raise the temperature of 2 kg of any substance (say, maple syrup) through a given temperature range (say, from 20C to 30C) as to raise 1 kg of the same substance through the same range. For a given substance, the "thermal mass," or resistance to temperature change, is proportional to mass. But you need an additional "fudge factor" (called "specific heat") because some substances change temperature more easily than others. It takes a *lot* more heat to raise the temperature of a kilogram of water from one value to another than to do the same thing to a kilogram of copper. You can combine the two effects and define a "thermal mass" (more conventionally called "heat capacity") for any object as the product of its mass and specific heat.

The important qualitative point is that the more of *anything* you have, the harder it is to produce any given change in it. This has an enormous range of important consequences. It is, for example, one reason why I have never been as enthusiastic as some about the idea of living in a small, self-contained, artificial space colony rather than on a planet. A planet, even a little one like Earth, has far more mass (literal or whatever figurative kind you may

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choose) than any space colony we're likely to be able to build in the near future. (No, I'm not ruling out the possibility that our descendants might eventually be able to build things as big as or even bigger than Earth. But that's a different situation altogether, and I'll be quite surprised if it happens *soon.)*

This means, among other things, that a planet is a far stabler environment to live in than any space colony we could build now. It would take a much larger natural disaster, or human error, to ruin it. (I suppose I must hasten to add also that this does *not* mean I think such habitats should not be built. All I'm saying is that there will be fundamental differences between living in one and living on a planet, and the two categories of lifestyles will appeal to different kinds of people.)

Stability, of course, can be both an advantage and a disadvantage. If you like the way things are, it's nice if they can withstand sizable perturbations without being radically changed. On the

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Analog Science Fiction/Science Fact (Astounding) is published every 28 days which includes special issues in January and July by Davis Publications, Inc. at $2.50 a copy in U.S.A., $3.25 in Canada. 1 year subscription for $34.95 in the U.S.A. and possessions, in all other countries, $40.50 (GST included in Canada, GST #R123293128) payable in advance in U.S. funds. First copy of new subscription will be mailed within eight weeks of receipt of order. When reporting change of address allow 6 to 8 weeks and give new address as well as the old address as it appears on the last label. Second-class postage paid at New York, NY, and at additional mailing office. Canadian 3rd class postage paid at Windsor, Ontario.

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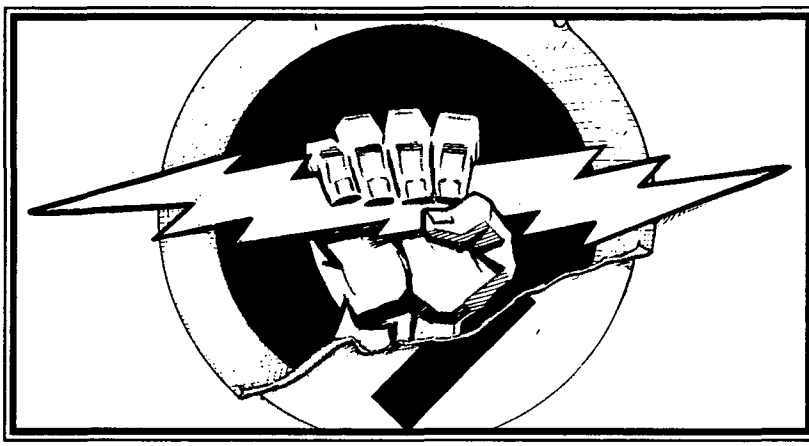

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other hand, if you don't like a thing, stability is a real nuisance. It means you have to work awfully hard to change it. It's a lot harder, for example, to fine-tune the climate of a planet than that of an apartment.

It's also harder to change the economic and social system of a large country than of a small club or company. Might we reasonably talk of "socioeconomic mass"? Offhand, I don't see why not. Admittedly, such a thing is not as easy to define in a mathematically rigorous way as inertial mass or "thermal mass." But the same general principle applies: it takes a lot more force (or "force-analog") to produce any given change in a big system than in a small one.

This line of reasoning has led me to a speculation that I find both interesting and disturbing. Maybe you will, too. It concerns that old bugaboo of free enterprise versus a tightly planned and controlled economic system. My gut reaction to the latter, like that of many other people, is extreme distrust. But consider this. . . .

Early electrical measurements were made with meters that used moving coils in magnetic fields. These worked fine for steady, direct currents, but were not all satisfactory for looking at the waveforms of high-frequency AC voltages. The problem was that the moving coil and attached pointer in even the best meter had an appreciable mass, and so could not follow rapid changes in voltages or currents. Doing that required the oscilloscope, sometimes described as a voltmeter with a massless pointer. The pointer isn't *really* massless, but effectively, it's very close — one electron as compared to a coil-and-pointer assembly on a meter. Again, it takes time for a massive object to respond to a force—so if you want fast response, you need something un-massive to do it.

Now, the fundamental assumption of free-market capitalism is that prices, job markets, and such will adjust to changes in social needs. The trouble is that our economy has now become a very massive object which cannot respond very fast. Yes, prices, job markets, and such *do* respond to ever-changing conditions—but they're such massive pointers that they are more likely to reflect the conditions and needs of a few years ago than those of *now*.

Up to a point, there's something to be said for this. Social and economic conditions are noisy. Superimposed on the major trends which have real, long-term, society-wide significance, there are zillions of little jitters which in the long run don't mean anything. A lot of effort could be wasted, and nerves frazzled, in trying to follow all of those. A *really* massless "social pointer" might be more trouble than it's worth.

On the other hand, pointers so massive that they reflect major trends that have already come and gone, rather than those now in progress, also fail to do what needs to be done. Mightn't it be nice to have pointers which are "semimassless"—i.e., able to follow the important trends on a scale of weeks or months, while ignoring day-to-day trivia? What form might such a pointer take?

One possibility that comes to mind is one that has been imagined in various versions by Isaac Asimov and other science fiction writers; a large computer

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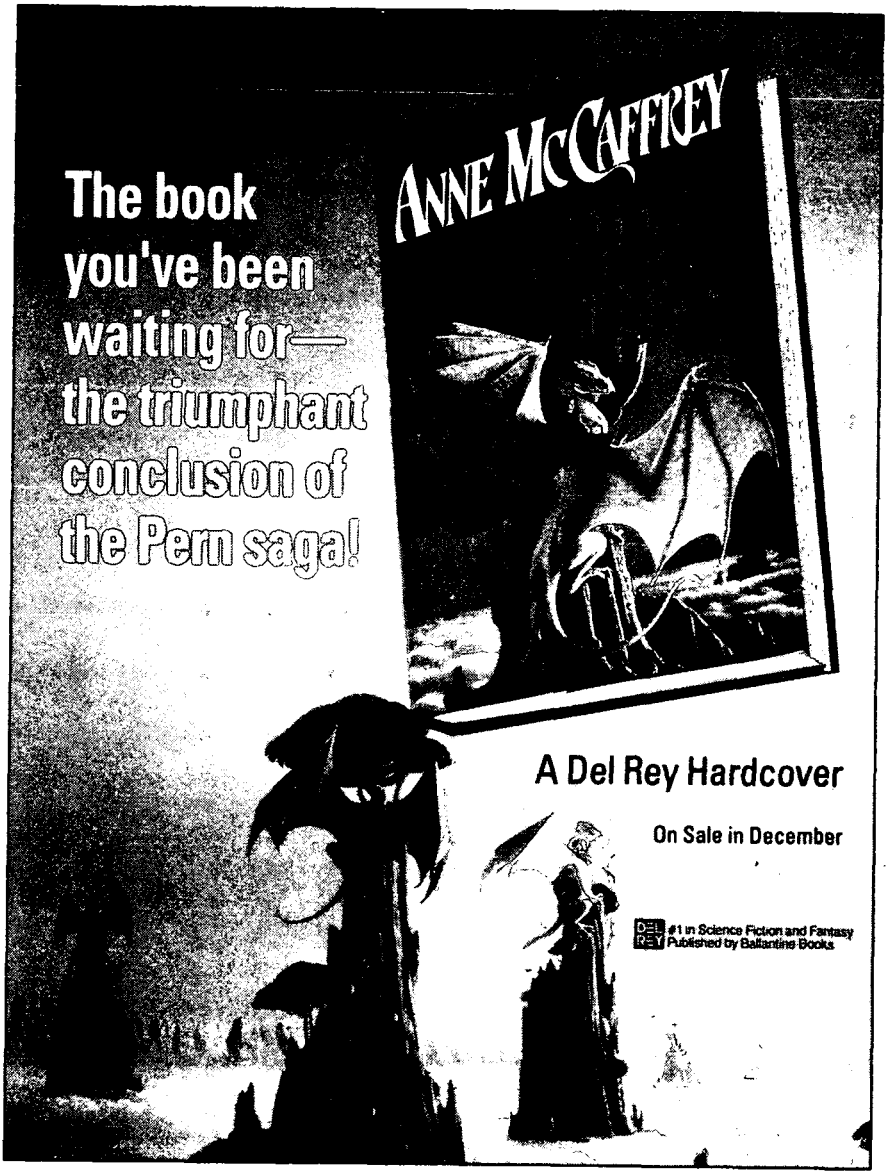
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that is fed comprehensive, up-to-date data on the current state of a society, tries out simulations, and recommends courses of action on the basis of the results. A computer simulation of a socioeconomic system might well be a pretty good analog of a massless pointer — something that could respond much faster than the real thing, telling what's needed so it could be implemented now instead of later, when conditions would probably have changed yet again anyway.

But how would it work? Real responses still involve changes in the massive system—and by the nature of massive systems, producing those changes will require the application of huge forces. Unless those huge forces can be replaced by small, *coordinated* changes in a lot of less massive parts of the system. . . .

But that coordinating requires the large-scale central management that many of us dread. *Should* we dread it, or should we be thinking now about how it might be made to work *for* us in the future?

History has given us ample reason to be distrustful, at the very least, of large concentrations of power in a small number of human hands. That's one reason why free enterprise has been such an appealing concept. Many people distrust machines even more, simply because they *are* machines—but that attitude is shaped less by reason than by emotion, and on the basis of very few years of experience. It may have to be revised, because the alternative may be worse.

Quite possibly some way will be found to combine the best features of free enterprise and the fast response that machine-aided modeling can provide. But one thing seems clear: when a socioeconomic system has become as massive as ours, monitoring and guiding it requires something far more responsive than our present combination of sort-of-free enterprise and the social equivalent of a 19th-century galvanometer. ■

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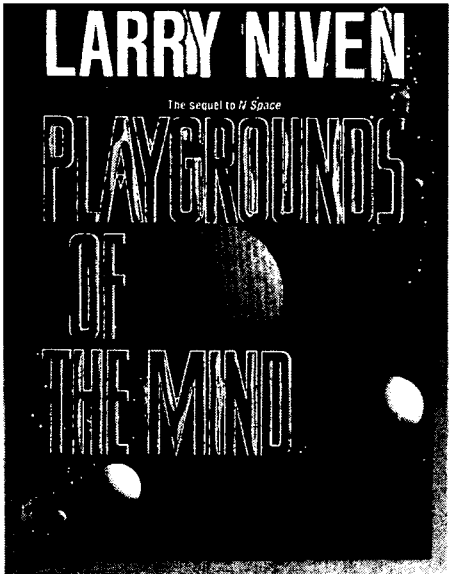

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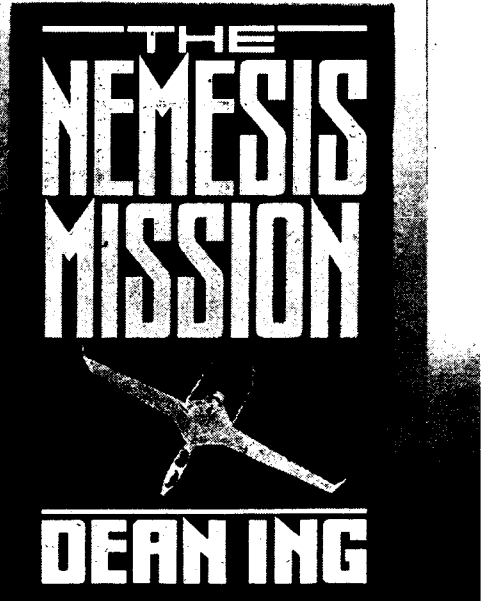

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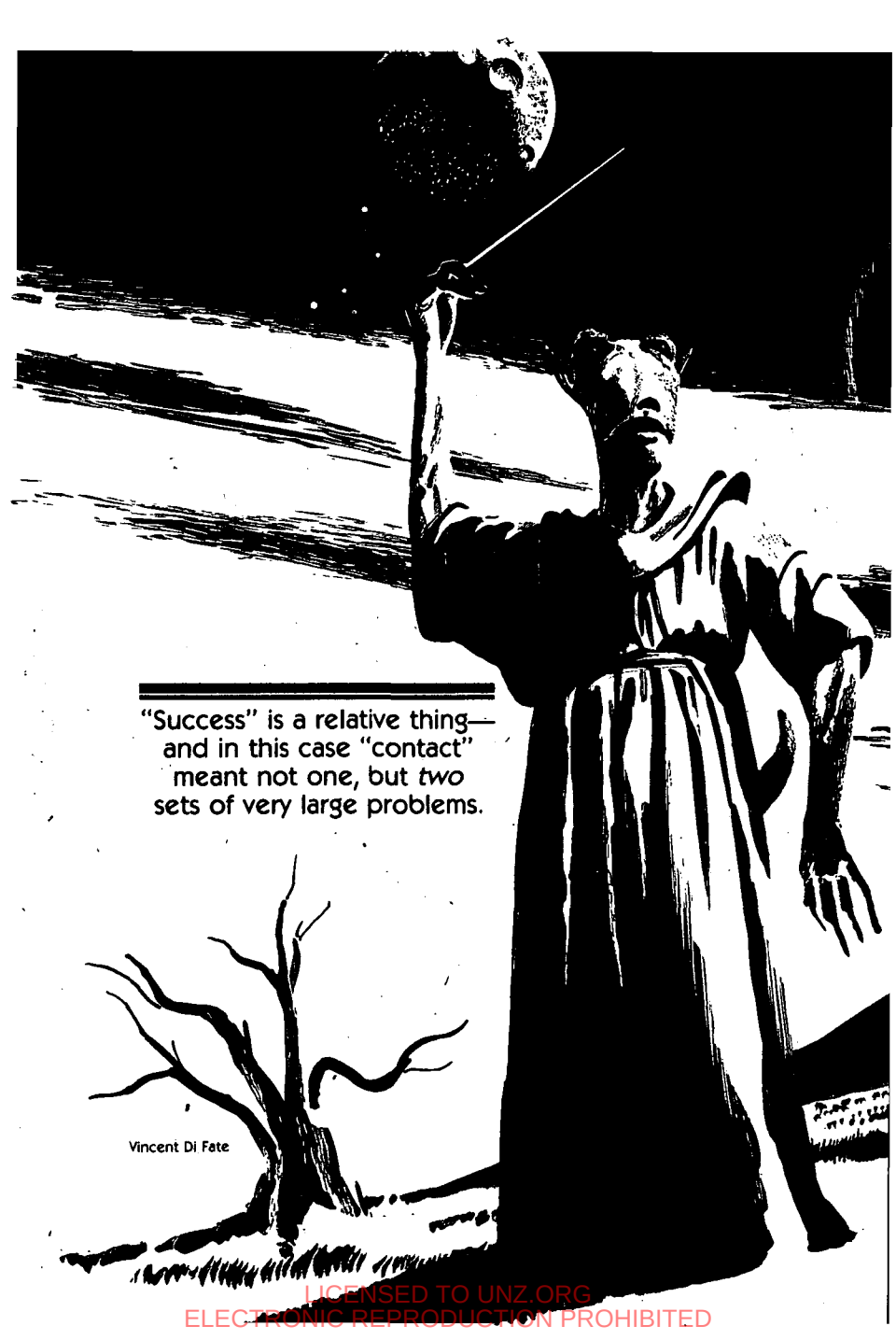

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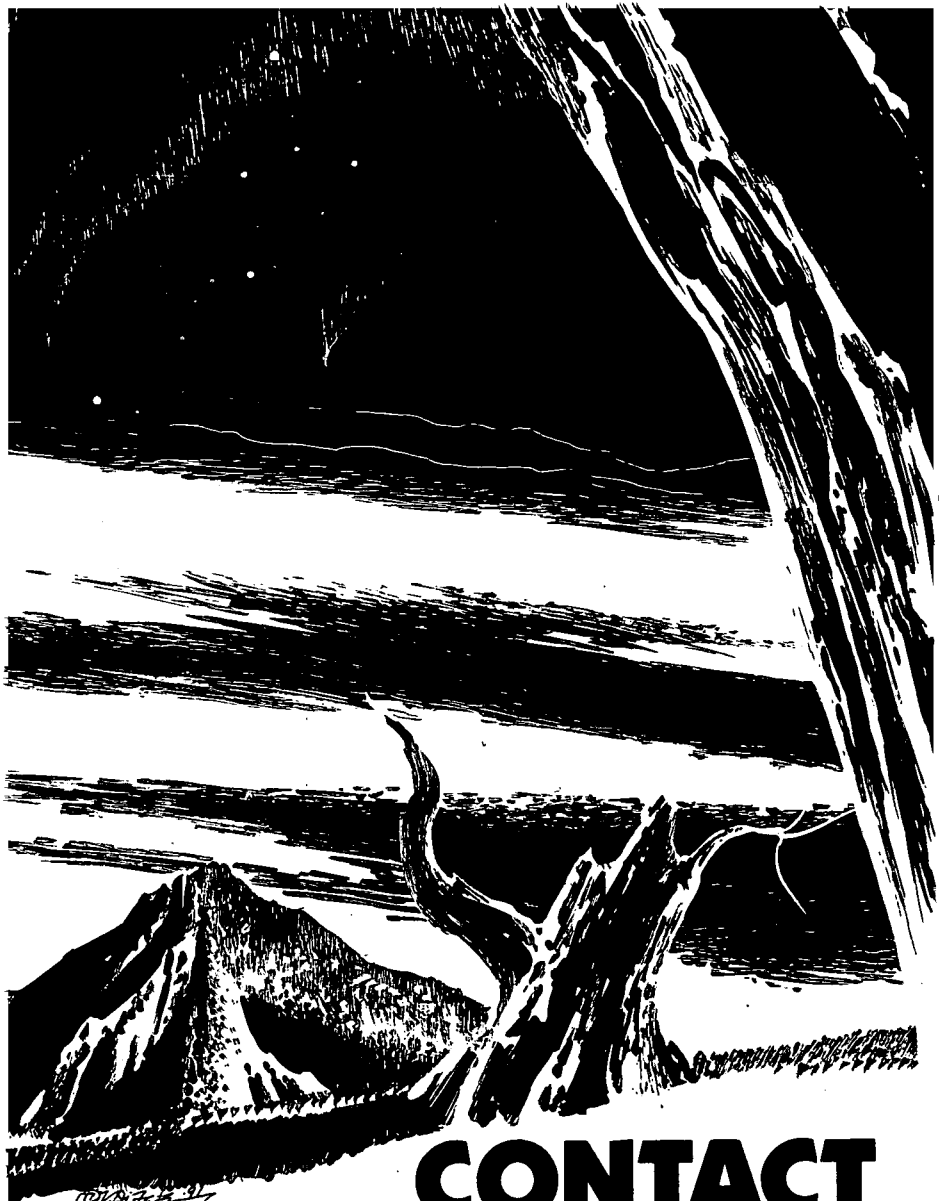

CONTACT

Jerry Oltion & Lee Goodloe

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The bloody light of Reddawn spilled across the morning landscape. Lurid shadows, black against red, stretched away from the gaunt trees limned against the sky, and icicles flamed crimson as they caught the dim light. Overhead, aurorae pulsated, dim with the coming dawn but still visible.

Old Phar, with the unconscious dexterity of long practice, began the Reddawn ritual, necessary to forestall the Red One's power before the Truedawn, when the Greatsun cleared the horizon. Breath steamed from his single nostril as he chanted the ancient liturgy, pointing the wand down, then toward the zenith, then accusingly at the Redsun peeking over the horizon. The motions and the incantations were so familiar, it was as though he stood apart from himself and watched a mechanism rattle through its cycle, like a waterwheel clattering in an irrigation canal.

Like individual lives, he thought. Noisy, sometimes seeming purposeful, yet always cycling, birth to death to birth . . . always moving, and always going nowhere. Such a boring plan for a universe. If *he'd* been God he'd've done it differently.

He reined in his thoughts. Careful! It wouldn't do to be thinking such heretical things now, routine ritual or no. He was no superstitious villager, to quake in the face of a phenomenon that repeated itself so regularly and drearily, but neither was he a fool. Those who blasphemed in thought eventually blasphemed in deed, and that would go over especially poorly in a priest.

Besides, the ritual had to have come from somewhere. Possibly it was only the time-dulled echo of a primitive tribe's fear of the unknown, but then again it might truly be a necessary devotion to ward off the evil of the Red One. The potential for disaster should that be so was vastly greater than the annoyance of performing the ritual; therefore it behooved him to pay attention.

Even if it *was* boring in its repetition.

Stop that! he told himself sternly, but not before he had smiled at the thought. He sighed. He was getting old, unable to keep a tight rein on his inherent evil nature. He hoped the True God would take that into account when the time came for the Final Battle.

A motion in the sky to his right caught his eye. Something bright. He glanced idly to the south, expecting to see a meteor, but there was nothing. He turned back to his chant. Motion again. He turned once more, this time looking more carefully, and what he saw then almost made him drop the tools of his office. A star. *Moving!* From the south. Moving steadily, arrogantly across the natural course of the sky, heading due north.

Awestruck—undoubtedly this was a powerful omen, to so defy the order of the sky!—he stopped the ceremony, his eyes fixed on the star. Stark terror tugged at him as he waited nervously for whatever was to happen next. He mentally rued his spiritual laxity the moment before, and prayed that the God would understand and forgive. By now the Redsun had cleared the horizon, baleful and tiny, blanched on its underside by the Greatsun's glare, and he quailed in its unnatural light.

The star approached the zenith. He cringed, knowing this would be the moment of his judgment.

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Nothing happened. The unnatural star continued on its northward course. Phar watched until it disappeared from sight behind the city wall.

Oddly disappointed, and not so oddly relieved; feeling a little foolish and more than a little disturbed, he finished up the ritual with more fervor than he'd felt since he'd been an acolyte. He chanted the final stanza just as the brilliant ball of the Greatsun cleared the horizon. Swamped by the glare, the red companion dimmed to near-invisibility.

In the ordinary, cheerful brightness of Truedawn, the strange star and its bizarre course seemed unreal. Part of his mind mocked himself: here he was, quivering like any ignorant villager. He looked around to see if his lapse had been observed, and sure enough, there against the temple wall sat one of the city's beggars, huddled beneath a threadbare blanket and blinking stupidly at him. Phar felt the first hot flush of shame before the beggar's expression registered with him. The beggar was terrified. He had seen it too!

Feigning confidence, for it wouldn't do to have a priest seem uncertain concerning matters of the heavens, Phar circled his finger in the sign of the Greatsun and held his hand high to the dawn in acknowledgment. Then he turned and started back to the temple, forcing himself to walk with the measured gait seemly for one of the Greatsun's priests. He was going to have to call a Council meeting.

Sixty years of dreams fled from the insistent buzz of the alarm. Tamara Volkova moaned softly and reached almost instinctively to shut it off, but her arms were sluggish and full of pain. They fell against the pillows far short of the mark. She lay back and breathed deeply, wincing at the ache in her chest. What was the matter? Why did she hurt so? Every muscle in her body telegraphed its distress. Was she hung over?

She tried again and managed to brush a hand against the source of the noise. That was evidently sufficient; the buzz changed to soft music. Tamara sighed and lay back again, blinking heavy eyelids and trying to focus on her surroundings.

She was in a bathtub full of pillows. A bathtub with a clear, domed lid, hinged open on the side. A NoMo tank.

NoMo. That explained it. It took a while to jump-start a person after years in suspended animation.

She searched her memory for particulars. What ship was she on? What mission? The answers hovered on the edge of awareness. Damn! Why couldn't she *think?* Waking from NoMo always did this to you, but that knowledge made it no easier.

The music threatened to put her to sleep again, but she shook her head and levered herself up onto her elbows instead. She could feel her heart beating with the exertion, and with the heightened blood supply came awareness.

The ship was the *Gregor Mendel,* and she was its captain. They were heading for—no, they should already be orbiting—the second planet in the binary star system AV +14 32 3324. The ship's sensors would have scanned the surface, mapping it while its passengers slept. So, unless it had hit a snag or required a second opinion on something, it was time to make the collec-

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tions.

The collections. Right. But first things first. Growing more alert by the moment, she swung her legs over the side of the cubicle, stood clinging to the NoMo chamber's lid until she could walk, then took the ten steps into the 'fresher, using chair, dresser, and bed for support on the way.

A hot shower washed away most of her aches, and turning the dial all the way to cold for the last ten seconds cured her lethargy. Glowing with renewed life, she dressed in loose sweats, padded into the kitchen and punched the coffee button, then took the steaming cup into her office next door and sat down at the desk console.

A fine layer of dust coated every horizontal surface. Sixty years' worth, she supposed, though it didn't look like much more than a few days' accumulation in a planetside apartment. The starship's climate control was much more efficient. She blew the dust away and turned on the computer with a thumbprint on the pad at the bottom of the monitor.

She verified that they were indeed in polar orbit around the right planet in the right stellar system—never hurts to double-check the autopilot, she told herself—then asked for an overview of the survey. The on-line intelligence responded with a set of pictures taken in visual wavelengths. She saw a planet with blue oceans, white clouds, and brown-and-green continents. Then came a series of frames of coastlines, major land masses, river systems, all taken at a resolution of about ten kilometers. No life was apparent in any of the views, but that didn't mean anything. At ten-kilometer resolution, it would be hard to spot life on any world. The computer switched to one-kilometer resolution, and that's when the life showed up. The color differences in the mountains were obviously due to forests, and the river valleys were full of vegetation as well. Hot damn, this looked like a live one. No scraping under rocks for a few species of microbes; this planet had a thriving ecosystem.

Pity it was all going to go up in flames in a few months, when the close orbiting M-class dwarf finally invaded its companion's Roche limit and began pulling material from the larger G-type star.

The computer showed her a few more scenes, then drew a box around the confluence of two rivers and zoomed in for an even closer look. Tamara gasped in surprise and dropped her coffee mug in her lap.

"*Chort,*" she swore, blowing the word out like a sneeze. She righted the mug and blotted up the worst of the spill with tissues from the full box on the desk, stealing glances back at the screen as she did. Finagle had struck again.

Of course they knew beforehand that the planet contained life—that's why they'd come here—but the probe that discovered it had been sent to observe the binary stars themselves, not their planets. It had given them atmospheric composition data and little more. They'd known something was releasing oxygen and methane into the air, but this was more life than they'd bargained on—and more responsibility.

Tamara sighed as she got up and stripped off her soaked clothing. She was going to have to call a meeting.

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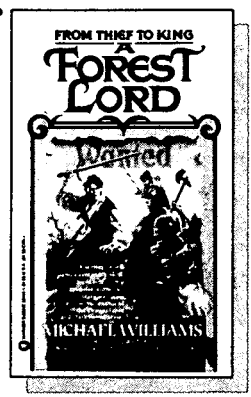

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* * *

Phar had called the Temple Council, as was his prerogative with his rank. The other senior priests crouched about the stonewood table, impressive in their vivid yellow robes of office. After the invocation, Phar stood up to full height. As the one calling the meeting, it was his duty to speak first. He was unaccustomedly hesitant. It was one thing to speak on ordinary matters of government, or to debate doctrine with stylized, formal rhetoric; it was even all right to discuss the action to be taken when some peasant had breathlessly claimed to have received some omen from the God, but it was quite another to tell his peers about a supernatural sign that he himself had seen. In fact, it was embarrassing. Still, everyone was waiting, and what else could he do?

He blurted it out in one quick sentence: "I was given a Sign at Reddawn matins."

He could see his colleagues shift position in surprise, and could feel the skepticism in their suddenly intent stares. Committed now, he told them matter-of-factly about the rogue star, how he had assumed it at first to be a personal sign directed to him for his lax thoughts, but how it had ignored him at the zenith. Finished, he sat down and awaited the inevitable cross-examination.

Temple-chief Khorph began the questions, as was his right. "You, of course, have not spoken of this to anyone." It was hardly a question.

"Of course not."

Khorph nodded. "If it did nothing other than cross the sky, why do you assume it was a Sign?"

"The . . . coincidence seemed a little unlikely."

Another priest, Tharn, laughed. "Who among us hasn't let our minds drift while performing the rituals? If that was sufficient cause for a Sign from the God, then the sky would never be clear of them."

Halfway around the table, Srandh said, "It could have been merely an unusual but natural atmospheric phenomenon. In fact, it could have been an exceptionally slow meteor. And, of course," he continued, spelling out what they all knew, "any merely atmospheric phenomenon is of the world and thus cannot be a divine sign."

Phar tilted his head in skeptical agreement. This wasn't going as badly as he'd expected. He said, "It could be, I suppose, but if so it was a most unusual meteor. It moved slowly and steadily, and it didn't change in brightness. None such as described in the ancient records."

Another priest spoke up. "Even though it ignored you at the zenith, Phar, it could still be a personal sign to you, and thus not relevant to anyone else." He spoke almost diffidently; "personal sign" was the euphemism for hallucination, and was used contemptuously of the hysterical peasants who intermittently appeared at the temple spouting their visions. Priests did not accuse one another lightly of receiving personal signs.

But Phar had suggested it himself. He again tilted his head politely and said, "Possibly. But if that is true, I shared the personal sign with a beggar resting against the wall. I doubt we were the only ones watching the sky at that hour,

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either, and I expect we will be receiving more—ah, more credible—confirmation very soon. And we must have determined what this sign signifies by then."

The Temple-Chief had, of course, already realized that. "If it's real, we certainly must do something," he agreed. "But even if it's a True Sign, it need not have come from the God." He paused significantly. "Phar, you saw this star traveling across the sky at right angles to the God's ordered course of the heavens. And you also saw it during Reddawn, while thinking blasphemous thoughts. I think it's plain that this portent comes not from the God but from the Red One."

A murmur of agreement rippled around the table.

Phar began to protest, but Khorph interrupted, "What evidence have you that this Sign came from the God?"

"Merely my own heart," Phar replied, with no hesitation.

Khorph moved his head sadly. "Phar, you *know* the tricks of the Red One. How could you be taken in so completely?"

Phar started to reply again, and then halted. Suddenly, the dialog was going very badly, and everything he said seemed to be making things worse.

Khorph stood. "This shall be our proclamation: The Red One's ways are devious, and his power exceeded only by the God's. Vigilance is always necessary to distinguish his apparitions from the God's. But the God does not mock his own works. The Red One always mocks." Again, the other priests nodded at this obvious inference.

"Our brother Phar is lovingly assigned to penitent meditation, that he may come anew to feel the true Presence of the God. He is relieved from his other temple duties for the duration of his penance."

A tumult of emotions seethed within Phar, but his lifetime's training held good. He managed to nod humbly.

"Last," the Temple-Chief said, "we command the Questioners to be especially vigilant. If our own brother could be fooled, how much more vulnerable the populace? If the shepherd is decoyed, the flock is easy prey for false herdsmen."

All at the table knew Khorph was referring obliquely to the ragged, self-styled prophets who intermittently preached heresy in the streets and squares. Unfortunately, however, the zeal of the Temple's Questioners did not generally confine itself to such blatant heretics. Old scores and new vendettas were also settled by the Greatsun's death in the public square.

Phar realized, with a faint wave of nausea, that he had unwittingly given the Question license for one of its periodic excesses. How, how, *how* could this meeting have gone so badly?

Perhaps the Sign was indeed from the Red One after all.

Tamara's meeting was going little better. She'd ordered the computer to awaken her five crew members—four scientists and the company's on-site accountant—but none of them could see their way around the dilemma either.

They all stared intently at the visuals displayed in the tabletop: a one-meter-resolution still photo of the river valley Tamara had seen earlier. The checker-

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board pattern of deliberate cultivation was as clear as a neon sign: They had discovered intelligent life.

No one needed to spell out the significance of *that*. The *Mendel* was there in the first place because of the scarcity of life in the Universe; it had been worth the effort to send a ship just to check out the possibility. Especially since the binary stars the planet orbited were due to sterilize their solar system only months after the nearest survey ship could get there. The *Mendel* had been that ship, but anything above the level of algae was so rare that they had come equipped to gather only microorganisms and tissue samples of any multicelled life they might find. The possibility of finding intelligence hadn't even been considered.

"Obviously," Tamara said after they'd all had a good look at the evidence, "this is an additional complication on our mission."

"Maybe not," Gordon Brown, one of the two microbiologists, replied. "The odds are overwhelming that it's a human colony. They might have already done our work for us."

The company accountant, Boardbill, shook his head. "Nobody would set up a colony here. The place is going to fry in less than a year. There's no way anybody would want to live here, and there's no way anybody who didn't want to live here could get a big enough return on their investment in such a short time to make it economically feasible."

"You sound pretty sure of yourself," Gordon said.

"I'm certain of it. Colonies are expensive; nobody's going to spend that kind of money on something that'll be gone by next tax day."

"They're alien," Huang Thomsen, the other microbiologist, said in a voice even more certain than Boardbill's. He had been playing with his tabletop display; now he hit the button that sent what he had done out to the others' screens as well. It was a computer-enhanced closeup of a castlelike wood-and-stone building, seen from about a forty-five-degree angle. Behind it a city of smaller buildings cast long shadows in the dawn light. It might have been an early colony town anywhere, save that directly in front of the castle's massive door stood a bipedal, two-armed, single-headed being that could have passed for human only on a very dark night. Though the rest of its body was hidden beneath a yellow robe, what showed was plenty to prove it wasn't human: Two overlarge eyes set in bumps on the top of its head, triangular ears placed just behind the eyes, a mouth that cut all the way across the center of the head like a gash through a watermelon, and a prehensile tail curling upward through a slit in the robe. A measuring bar beside the figure, corrected for perspective, showed it to be about 1.2 meters high.

"This will make the Parallel Evolution camp back home quite pleased," Emily Kouris, the immunologist, said. There was an eagerness to her voice that betrayed her own pleasure at being in on such a unique discovery.

Mary Burke, the astrophysicist, said, "True enough. Provided we can figure out how to take some of these guys back with us, of course. And whatever we can salvage of their culture."

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Boardbill cleared his throat. "In the strictest sense of the mission objectives, that is not a high priority. We are here under a standard biological survey contract, which calls for samples of genetic material from all life forms encountered. When appropriate, samples of entire organisms may be preserved for study, but the contract says nothing about the rescue of any alien culture."

"Does this contract say anything at *all* about an alien culture?" Tamara demanded.

"Yes, in fact, it does," Boardbill replied. "If we encounter signs of intelligent life, we are to report the details of same to the home office, return to NoMo, and await further instructions. Under no condition are we to attempt contact."

"Even if they blow up while we're waiting."

Boardbill at least had the decency to blush. "That is correct."

"Well, that shows how valuable a contract can be. If we held to the letter of that one, they could probably prosecute us under the Genocide Act." Tamara sighed. "We can't just treat them like any other animals."

"No one is suggesting we just abandon them," Boardbill said, shifting his tack slightly. "Obviously we should rescue as many as we can. But we aren't equipped to evacuate an entire planetary population, especially one so primitive. We don't even know if the alien physiology will tolerate NoMo."

He looked around him, seeing the hostile expressions on his shipmates' faces, and added, "I know this is a unique situation, but we should not forget our obligations to our stockholders. They financed this expedition as a speculative venture, and have a right to our best efforts to fulfill that contract. We are here to collect the broadest possible sample of living things for their possible commercial value. That should include intelligent natives, obviously, but we shouldn't ignore the rest of the biosphere. This is by far the most diverse ecosystem we've discovered since humanity left Earth. The possibilities—"

Mary could hold herself back no longer. "My God! You're talking about obligations to *stockholders* when there's a planetful of *beings* down there who're going to be incinerated! Why you cold-blooded—"

Tamara banged her first on the tabletop. "Hold it! We can discuss this without calling each other names." She tilted her head slightly, looking at Boardbill out of one eye. "All the same, Mary has a good point. The legal considerations, not to mention common morality, obligate us to do what we can. Certainly the circumstances would absolve us from any *legal* liability for breach of contract with the stockholders." She emphasized the word slightly for Boardbill's benefit. "However, as you've pointed out, our resources are limited, and there's still good reason to carry out our other biological collections. If nothing else, higher life forms, whether intelligent or not, can't survive without microbial ecosystems."

"Fine," Boardbill said. "Let's save the entire ecosystem. That's what we're here for, after all. But let's not let our sympathies get in the way of our mission. We're here for DNA, not pottery."

Huang shook his head. "Intelligence

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isn't just another higher life form, Boardie. These guys'll have cultural traditions that could be every bit as important as their genes. They'll have distinctive artwork, artifacts, legends, languages . . . all sorts of things. We'd be criminals to let an entire civilization go up in smoke because we were too busy saving the local equivalent of earthworms."

Tamara nodded. "I agree. We're going to have to save as much of their culture as we can. But we're under more than just a space constraint. Mary, how much time do we have?"

"Still four to six months till the Roche lobe spills over, approximately," Mary replied.

"Approximately?" Tamara glowered at the astrophysicist.

Mary stared back at her. "Approximately. It's a chaotic system. We can only make statistical predictions. Small variations in the drag yield large differences in the rate of the orbital decay. Large and nonlinear."

"Give me a lower limit. How long have we got for certain?"

Mary frowned. She tapped at the monitor in front of her, frowned even deeper at the results. Finally she said, "Three months with certainty. Five months at 90 percent safety margin. Beyond that it gets shaky."

Three months, Tamara thought. Three months—or maybe six—until the magnetic drag of the close, rapidly orbiting stars finished the job it had been working on for millions of years. Already the G2 star nearly filled its Roche lobe, drawn out into an elongate blob by tidal forces. Soon gas would start spilling out of the lobe and spiraling onto the dim, M8 companion—and incidentally sending a hurricane of hard radiation sleeting through the planetary system.

Tamara knew she couldn't coax any better figures out of Mary, either. They had brought along an astrophysicist precisely because the close binary system was so unpredictable. Mary was their alarm; when she decided star-stuff was about to start spilling onto the M8 dwarf, they would pull up stakes and get out with whatever they had managed to collect. Fast.

Tamara made her decision. "We plan for three months, then. We use both landers simultaneously, despite regulations to the contrary. One lander, with Gordon, Huang, and Emily crewing, will go for samples in a remote area while the other, with Mary, Boardbill, and myself, will attempt contact with the aliens. We both collect as much as we can stuff into the hold in that time. If Mary says we have more time, we extend our stay accordingly. Questions?"

Emily and Boardbill both looked unhappy, and it was clear that each wished they were on the other team. Tamara considered switching them, but decided against it. Emily was a biologist and Boardbill was not; she would be more useful collecting samples. And Boardbill—Tamara wanted to keep him close at hand, where she could keep a close rein on him.

"No questions?" she asked again. When nobody replied, she said, "Then I've got one. Just how should we go about contacting these guys?"

"Are we missing the obvious?" Gordon asked. "Has anybody listened for

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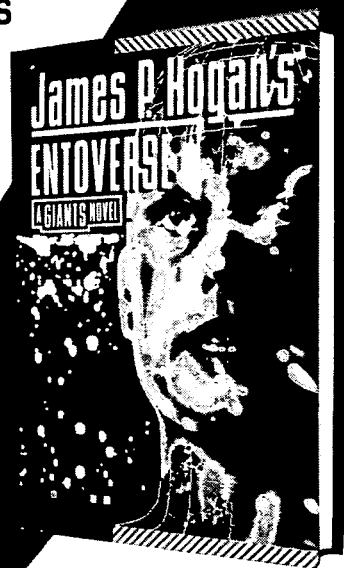

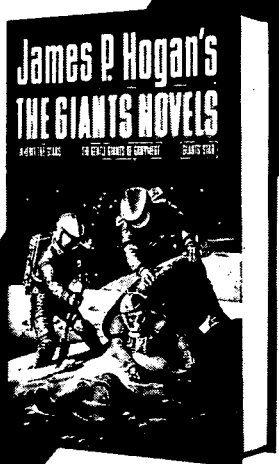

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radio?''

''The system is clean,'' Tamara replied. ''There don't seem to be any modulated energy sources on the entire planet.''

''Hmm.'' Gordon pursed his lips in thought.

Huang said, ''There have to be guidelines for contact somewhere in the library.''

Boardbill's eyes grew wide. ''Of course,'' he said, and began tapping on his monitor. Within seconds, he had dragged the document out of the computer's archives and began to read: ''Recommendations of the Federated Republic of Inhabited Worlds Committee for the Development of Procedures for the Establishment of Extraterrestrial Contact.'' He tapped the screen for more information. ''Authors' names —'' tap ''—authors' biographies —'' tap ''—more biographies—'' tap ''—acknowledgments, more acknowledgments, still *more* acknowledgments, official seal, disclaimer of liability—ah, finally: the table of contents.'' He whistled softly. ''Looks like we're in for a good time. Chapter one: General Guidelines for the Determination of the Existence of Intelligence, 1.2 megabytes. Chapter Two: Special Cases Wherein the General Guidelines for the Determination of the Existence of Intelligence Might Not Apply, 2.3 megabytes. Chapter Three: Elementary Precautions for Preventing the Exchange of Contaminating Ideas While Determining the Existence of Intelligence, 1.7 megabytes.''

''Sounds like the committee is definitely interested in preventing the exchange of ideas,'' said Mary.

Emily laughed. ''Reminds me of an old joke. Why did it take 10 billion years to create mankind, instead of six days?''

''I don't know,'' Gordon said. ''Why?''

''Because God is really a committee.''

Laughing, Tamara said, ''So what does that make us, then?''

Huang looked down at his own monitor, still displaying the computer-enhanced close-up of the robed alien, and said, ''I imagine that depends on your point of view.''

A subdued but sullen throng crowded the Temple's plaza. Phar had lots of time to watch them from his cell where he mediated, prayed, and revised his translations of the Hallowbook into *Sphranath*, one of the languages of the savages who dwelt on the edges of the Realm. The nightly sightings of the Roguestar—so it was now officially named—had fanned uneasiness, uneasiness that was slowly escalating into panic. That panic wasn't limited to those beyond the temple walls, either. The frightened masses looked to the Temple for guidance and support, but its obvious impotence against—and rumored confusion about—the indifferent light in the sky had betrayed them deeply. Their dawning resentment could easily be crystallized into anger directed at the Temple itself.

In fact, so he'd heard, the entire Realm was seething. Despite the threat of the Question, street preachers openly proclaimed that the errant star portended the Final Battle of the Suns, when all Worldly life was to end and

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the One God rewarded the righteous. And those preachers were attracting large, responsive crowds, crowds that later would openly defy the Temple's authority.

At least, Phar thought wryly, no one now doubted that he *had* seen what he'd reported. And the mob at their doorstep had diverted his companions' attention from his own case. But Phar nonetheless wished that the reality of the apparition had been confirmed less overwhelmingly. Corrupt and cynical the Temple might be, but it was stability, and order, and learning, and Phar had no wish to see it threatened.

He breathed a silent prayer to the Greatsun and returned to his studies.

Moments later, a deep, thunderous crash interrupted him. Startled, he looked out his window again, wondering how a storm could have blown up so quickly, but the sky was clear in all directions. He swept his head around again, looking for the fallen building or the explosion that could have caused such a noise, but aside from the suddenly agitated crowd he could see nothing out of the ordinary.

The rumbling died away. Most of the crowd had their heads craned back, looking frantically at the sky, their eyes darting this way and that. Some clutched weapons—staffs, knives, here and there a sword—but most held their arms out before them, fingers circled in the sign of the Greatsun.

A shrill keening that did not come from the crowd waxed louder, louder, *louder*. All at once a gigantic flying thing—bird? beast? demon?—crossed the plaza, trailing thunder in its wake. Phar had a quick, confused impression of shiny hide, wings, extended claws, and it was gone. For all its speed it had seemed curiously rigid, like a wagon or sled, with none of the sway of limbs or play of muscles of a living creature.

He leaned out the window for a better look, holding on with one hand and wrapping his tail around a leg of the desk. The flying thing had vanished . . . no, there. A brilliant flash winked from low in the sky, like a heliograph signal. Was it *metal* then, to reflect the light so?

As the noise of its passage died once again, Phar heard a more familiar—but no less frightening—roar from below. Chaos now reigned in the plaza. A full-scale riot had exploded in the flyer's wake, some of the rioters attempting to flee the Temple while others attempted to force their way in. As Phar watched, a line of soldiers advanced upon them, steel drawn, forcing the mob before them. They were too few to maintain a continuous line, however. Behind them, crossbowmen fired intermittently at figures trying to break through. A bolt *thunked* into one figure, who sprawled forward, his knife clattering onto the cobbles. Before the knife had stopped moving another rioter picked it up and slashed at a soldier. The rioter went down a moment later with a nearly-severed head, his bright blue blood startling against the pavement, but the soldier bled from a wound to his side. In a moment he was overrun, and the crowd made a surge for the gate.

The keening—almost a shriek, really—was getting louder again. Phar looked to the sky once more and saw a black speck moving improbably fast against the blue background. It seemed

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to be slowing, though—no, maybe it was turning toward them. He lost it against the city on the other side of the square, then picked it up again: huge, implacable, and coming directly toward him!

He ducked involuntarily. When he looked out again, the flyer had stopped. It was now hovering over the square, looking for all the world like one of the Red One's minions ready to pounce on the recently released souls from the battle beneath it. Except, again there was that curious rigidity about it; no wings flapped, no muscles rippled. Could such an—an *object* truly be a demon?

It started to descend, easily and swiftly and quietly, and landed with astonishing grace in the cleared plaza, back of the soldiers. Training—or perhaps just common sense—kept them facing the mob, but the fighting had stopped the moment the thing had come to a stop overhead.

As its feet—not claws after all, Phar noted—touched the paving stones, Phar left his cubicle. His time of penitent meditation was over.

The guidelines for contact had been full of detailed advice on how to arrange a first meeting that wouldn't destroy the very culture they were trying to contact. The trouble was, all of it assumed that the expedition would have unlimited time. In the end they'd had to throw the whole thing out and start from scratch, coming up with their own plan to expedite matters.

Step one: Show of presence. Tamara winced at the thought, but the crew had agreed it was the best way. If everybody knew they were here from the start, there would be no time wasted in convincing anyone that aliens from a higher-technology culture had arrived.

They'd picked the same city that the computer had shown them in the survey photo. It was the largest one on the planet, with the most intensive agriculture surrounding it and the most elaborate road system connecting it with the smaller towns nearby. Odds were, it would be the seat of government. What kind of government—or what kind of anything—they would be trying to deal with was still unknown, but there seemed to be some kind of organization there, and that was what they needed to contact. Someone organized.

Tamara sighed and spoke to the autopilot. "Make one low pass, high speed; photograph and analyze the photo for a landing place near the largest building in the city. Then if possible, return and land, leaving ample clearance to avoid injury to ground personnel." She suddenly wondered if the system would recognize the aliens as "personnel," and decided to make sure. "That includes any living being larger than a cat," she added. "Land if possible, otherwise make another pass. Iterate until further instructions.

"After landing, remain on standby status in eavesdrop mode. The landing party will be wearing holo cameras; record all speech and action for later linguistic analysis. Listen for orders as well. You are to recognize and respond to the following people as well as myself: " She nodded to Boardbill and Mary.

"Genghis Boardbill," Boardbill said with the defiant expression of one who has carried such an appellation for many

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years. Tamara tried not to smile.

Mary did. "Mary Burke," she said, the giggle not audible in itself but evident in the timbre of her voice.

"All right, you know what to do. Do it."

The three of them waited impatiently in their acceleration couches while the ship dropped out of orbit and executed its maneuvers. They already wore their planet suits: the clinging silvery skin and clear helmet used to maintain biological isolation from the surface environment. The suits were tough, intentionally made hard to breach in an accidental scrape or fall, but they weren't armor, and as the moment of contact approached, Tamara worried more and more about that failing.

Finally, after a wild ride over the city that would have gotten them shot out of the sky on any human world, the autopilot slowed the shuttle to a hover, extended the gear, and landed. The whine of engines wound down the scale, revealing an underlying whine of hydraulics as the autopilot deployed the gangplank.

Tamara unbuckled and went over to the airlock. Mary and Boardbill were right behind. Out the port they could see part of an alien-filled plaza and a wall of the building behind it. Its architecture was astounding considering the materials used: an ornate dome tapering into an equally ornate spire, both intricate with carvings and filigree. Buildings like that hadn't been seen in human society since before the dawn of space flight.

"Open outer door," Tamara said, and the autopilot obediently raised the hatch.

There was a flicker of motion, and something clanged against the inner door. A moment later dozens of somethings did the same. One fell within view in the airlock: a short, shattered arrow.

"Crossbow bolts," Boardbill said. "They're shooting at us."

They had accounted for that in their plan. "Autopilot, give them a demonstration of our firepower," Tamara ordered. "Don't hurt them, but impress them. Shoot something."

Left to its own choice, the computer weighed the context of the words in the commands it had been given, and decide that "impress" must be fitted by shooting a physical object that could be seen by the greatest number. So it targeted the laser cannon at the highest object around, the spire atop the temple, and fired. Blinding red light lanced out from the shuttle, and rock spattered into lava where the light caressed it. Undermined, the spire slowly buckled, crumbling into a mass of rubble. Individual blocks of broken masonry bounced off the temple dome, obliterating ornamentation, powdering carvings, shattering into potentially lethal shrapnel as they did so. One block crashed right through the dome.

It was a singularly poor choice of target, especially considering the color of the laser. A second volley of arrows bounced off the inner door, one of them starring the porthole glass, and this time the people behind the soldiers joined in the fray, throwing rocks, knives, and whatever else was at hand.

An alarm buzzer sounded from the airlock control panel, just as the autopilot said, "Alarm, alarm. Primary hatch

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control system damaged. Switching to backup."

"Close the door!" Tamara ordered, and the outer door slid shut. "Open the inner door." The inner door slid aside, revealing dozens of broken arrows and one intact one neatly spearing a hydraulic line. Bright red working fluid oozed out around the shaft.

"Fix that puncture," Tamara ordered, and as a pair of small maintenance robots—"fixits"—crawled out of their niches to obey her command, she turned to Mary and Boardbill. "Well, so much for instilling them with a sense of awe," she said. "Now what?"

"I would suggest going on to step two: attempting to communicate," Boardbill suggested.

"Mary?"

"Can't hurt, I guess."

Tamara nodded. This was the part she'd been dreading. Turning back to the control console, she said, "Autopilot, put my voice over the P.A. system on my mark." She thought a moment, trying to decide what to say. She knew the aliens wouldn't understand a word of it, but her speech would also be heard eventually on a thousand worlds, the occupants of which *would* understand—and criticize—every word.

When in doubt, cover your ass, she thought. "Recall that first contact document," she ordered. She paged through it on the monitor until she came to "Suggested Opening Speech" and nodded. "OK, mark."

She took a deep breath and waded into it: " 'We come in peace. We are members of a race of beings who make our homes beyond your sky. We have come here seeking knowledge, and bearing knowledge in trade. We wish to establish friendly relations. . . .' "

She read on and on, hoping they would eventually get the idea that she was trying to communicate.

Phar strode down the corridor connecting the dormitory with the main cathedral. It was a scene of bedlam: people running both ways, crashing into one another, shouting orders, opinions, questions—it all blended into gibberish. He pushed his way through, his yellow robe of office helping in that task, until he reached the great domed chamber where the priests gathered. Khorph was there, but only three others; the rest were probably cowering under their desks. Phar looked at the enormous stone block resting where the conference table had been, and at the matching hole in the dome, and understood why.

"Do you doubt your rogue star's allegiance now?" Khorph asked dryly.

"It is not *my* rogue star," Phar replied.

"Oh, but it is. It is yours to exorcise, at least." Khorph turned to one of the other three priests at his side and said, "Tharn, get Phar a censer and a blessed staff." As Tharn turned to obey, Khorph added, as an afterthought, "Get the same for yourself and Srandh as well. You can both help Phar in his duty."

"You want me to *exorcise* that—that *thing?*" Phar asked incredulously.

"You have a better idea?"

"I think we should find out why it's here first," Phar answered.

"It's here to defile our temple and undermine our power," Khorph said

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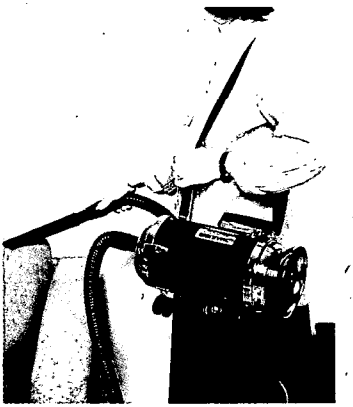

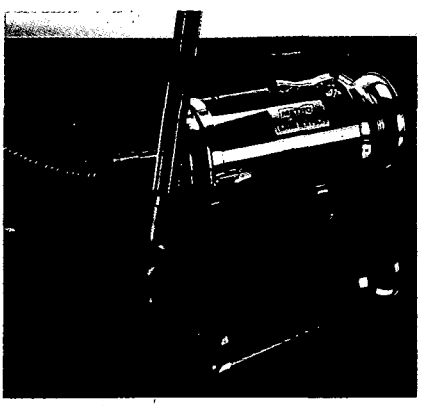

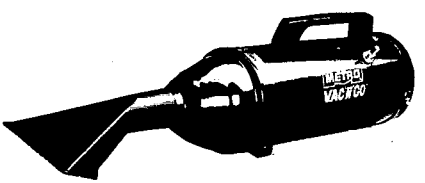

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impatiently. "That's sufficient knowledge to act upon. We've got to show that mob outside we're dealing with the situation or they'll be on this side of the wall within the hour. Hence the exorcism. Of course, if you manage to scare it away, then so much the better."

Khorph's meaning was not lost on Phar. An exorcism drove away the evil spirit in an object or a person; it didn't necessarily drive away the object. The laity knew it was a dangerous procedure for the priest—they had been told so often enough—so even if the thing killed Phar and his two "helpers" in the act, the priesthood could still declare the exorcism a success. In an exorcism, *any* result short of total annihilation was considered a success, and if the thing outside was going to do that, chances were the exorcism wouldn't affect it a bit.

"What if it truly is a demon from the Red One?" Phar asked softly.

"Then you'd better hope your exorcism works," Khorph replied.

There seemed to be little more to say. Phar and Srandh waited while Tharn fetched the exorcism equipment; then the three of them lit their censers, took up their staffs, and marched out of the temple, Phar in the lead.

The procession moved out, chanting and waving their censers with their tails and banging their staves upon the floor with each step. As they neared the plaza they could hear a loud, unnatural voice speaking in an unfamiliar tongue, and Phar clutched his censer tight in fear. The True God and the Red One should both have known their language. What *was* that thing?

The soldiers had ceased shooting at it, and the mob had run out of things to throw. The appearance of Phar and the two priests flanking him sent a murmur through them, and they parted to let the yellow-robed figures through. Phar kept his eyes fixed on the silvery monster before him as he took the dozen even, measured paces necessary to bring him to the base of the thing's tongue.

He banged his staff twice on the stones, worked his throat nervously, and began the exorcism.

"Uh, Tammy?" Boardbill had been looking out the airlock window, but now he turned away to address the captain.

She turned toward him, reading, ". . . Federated Republic of Inhabited Worlds. It is sincerely hoped that . . ." and raised her eyebrows in question.

"Something's happening outside. Three guys in yellow robes are at the bottom of the gangplank, waving smokers and banging sticks on the ground and the one in front is chanting something at us."

". . . in a brotherhood of peace and prosperity and do you think they want to talk or are they just taking aim for another volley?" she asked without breaking stride.

"Things look pretty calm right now," Boardbill replied.

". . . and justice for all. Have they got that hydro line fixed yet, Mary? Accordingly, we extend this greeting . . ."

The fixits had pulled the arrow loose and were wrapping tape around the pipe to seal the hole temporarily. Mary looked at their handiwork. "I think so," she said. "We won't know for

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sure until we try it."

". . . and with it our blah, blah, blah. Well then, let's give it a go. You there outside, do you hear me?" She stopped speaking for the first time since she'd begun her address.

"They're still chanting and waving their smokers," Boardbill reported.

"Come back inside and let's try opening the outer door again."

Mary and Boardbill did so, and the autopilot opened the door at Tamara's command.

"No crossbow bolts this time," Boardbill said. "The one in front is saying something to the crowd."

"Good. Autopilot, let us hear what he says. Hello out there. Can you understand me?"

The alien's voice, surprisingly deep for such a small creature, said something that sounded like "Siph pharan dhos wilner sondha."

"Hello, can you understand me?" she asked again.

"Zoph phurona dha wayner sandhu," the alien replied.

Tamara sighed. "Well guys, this is it. Autopilot, cease broadcasting my voice. You two, get to either side of the door and stay out of sight. I'm going out. Autopilot, do what you can to protect me, but don't harm anyone. That goes for you guys as well. We're here to save these people, not kill them. Understood?"

"Understood," Boardbill said, and Mary echoed him.

"All right. Autopilot, open the door."

Phar had just finished the second Invocation of Holiness when the demon's voice underwent a subtle change in tone. He held his censer higher, mentally called upon the Greatsun's power to help him survive whatever came next, and launched into an Iteration of Piety.

The voice resumed its previous tone for a moment, then changed again and came to an unexpected stop. Phar braced himself for annihilation and finished the chant, but the only response was a short sentence from the demon.

The crowd began to murmur. That wouldn't do! He banged his staff on the ground again and called out, "What is your purpose here?"

The demon spoke again, a single, short phrase, and opened its mouth.

He heard the crowd gasp as one person. Knowing what would come next, he whirled around and shouted, "Keep your weapons down!" The soldiers carrying only swords needed no convincing; the crossbowmen were more reluctant but they too bowed to the figure of authority.

The demon voice spoke again.

Phar turned around to face it again, saw that the mouth was straight-sided and rectangular, like a door. *Just* like a door, he thought.

"What is your purpose here?" he demanded again.

The demon-with-a-door responded with more gibberish, a few sentences.

Phar tried again with a different dialect, received another unintelligible answer. He was about to try yet another when a second door opened behind the first and a tall, silvery being stepped out.

At least it's not red, Phar thought.

The silver creature spoke a short

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phrase and waited for a response. Phar said, "Your words are foreign to me. Do you speak the language of this Realm?"

The creature spoke again. Phar tried again with another dialect, and again, with all the languages he knew. Each brought gibberish as a response.

The silver creature obviously knew none of the languages he did.

"What are we to do now?" Phar asked conversationally in the secret inner-temple tongue used between priests, but before either Tharn or Srandh could reply, part of the answer came from the demon's aircraft. Phar's own voice, much amplified, boomed back at him. *"Your words are foreign to me. Do you speak the language of this realm?"*

Utterly astonished, he staggered back, nearly dropping his censer. He remembered his dignity in time, however, and caught himself, but not before he had burned his tail on the hot brass. The demon pointed at itself and said something, then pointed at Phar and said something else. Last, Phar's own voice boomed back again—less startling, this time. Now the demon gestured toward the doorway through which it had appeared.

The implication was excruciatingly obvious. The demon wanted to learn his language, and wanted him to come inside that ghastly—craft—for lessons. Phar looked around him as a drowning person looks for a life raft, but no assistance was in evidence. All eyes in the plaza were upon him, and in some of them he could see the open challenge of the heretic who is about to receive proof that his lack of faith is justified. That wouldn't do at all. Phar was going to have to do it.

Tamara stared bleary-eyed at the alien seated in the camp lounger across from her. They were in the shuttle's cargo compartment, in the quarters they had set up for the alien while they learned each others' language. It had been a marathon session, and Tamara felt like collapsing to the floor and sleeping for a couple of months, but after three days' intensive effort—broken only when the alien left to eat and relieve himself and, presumably, report to his superiors—they had finally built up a working vocabulary. Most of it resided within the autopilot computer, which had inferred the grammatical structure based on recorded conversations and which now acted as a translator, but the job of actually speaking to the alien had fallen to her. The alien (Phar, with a bilabial fricative, she reminded herself) would listen to the computer as a translator, but he wouldn't converse with its disembodied voice, or even to a face on a screen.

But at least they were speaking, and he had finally accepted that they were what they said they were. Today had been a breakthrough day in more than just vocabulary.

"You say you come from beyond the sky," Phar said. "I have no great difficulty believing that. Yet you are not one of God's messengers, or even *from* one of God's messengers. That is what I have difficulty understanding. Where else can you be from?"

Tamara tried to compose her answer beforehand, to avoid talking herself into a corner. "God's messengers" were the aliens' name for the other planets in

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their solar system, so she said, "We're from a planet—that is, a world like this one—that 'orbits' another star—that is, another sun—just like your world and the messengers go around your own suns." She spoke in Standard. The computer translated it for her, speaking phrases that sounded a little like her father's ancestral Russian, and beeping at her for elaboration when she used a word it couldn't translate.

Phar was sitting on his tail, but the end of it lashed in agitation. "The World is the center of the Universe," he said with finality. He spoke in his own tongue; Tamara listened to the computer's translation.

Tamara shook her head. "The World is a ball of rock and water and air," she'd said. "So are the other planets you call the messengers. They look like moving stars in the sky simply because they're far away."

Phar said slowly, "We have known for centuries that the World is round. Heretics—" he emphasized the word "—have suggested that the World also circles the Gods, but that is obviously nonsense. Anyone can see that the Gods—and the messengers—circle the World."

Tamara sighed. She hadn't realized that the physical concepts she'd taken for granted since childhood were really so non-intuitive. She said, "It's not nonsense. The World does circle the Suns, and so do the messengers."

"I do not believe that."

Frustrated, Tamara said, "It doesn't matter. The point is, we're from a very long ways away. Much farther than the Suns or the messengers."

"I have difficulty believing that as well," Phar said, "but we will leave it for now. Tell me instead why you have come here."

"To collect samples of the life on your world," Tamara said. "Life is rare in the Universe. When we learned that it existed here, we came to see what new types we would find. But we didn't expect to find *you*."

"Why not?"

"Our kind of life, intelligent life, is the rarest kind of all. You are the only other ones we have ever met in hundreds of years of searching."

"We have been here for longer than that," Phar replied. "We will be here still longer."

There would never be a better opportunity than this, Tamara thought. *Here goes.* "Uhh—well, that's not quite the way it's going to work out. You know that the Redsun and Greatsun go around each other?"

Phar made a sweeping gesture with his hand. "Certainly. The smallest child can see that."

"Well, the size of that circle—that's what we call its 'orbit'—is getting smaller due to friction." The computer buzzed at the word "friction," and she sighed. Another unknown concept. "It's like a ball rolling across the floor," she explained. "You know the ball will eventually stop. It stops because it feels a force pushing back on it from the air around it and from the surface of the floor. We call that force 'friction.' "

Phar circled one of his thumbs and a finger in the gesture Tamara had come to realize meant agreement. "It's natural for Worldly objects to stop. That's a forced motion; it must vanish. But

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circular motion is natural for the heavens, and will not vanish."

Tamara shook her head again. "No. There is no difference between worldly matter and heavenly matter. Once moving, all things want to keep moving. The only reason they stop, or change direction, is because other things push on them—exert forces on them."

Phar plainly did not believe that. She plowed on nonetheless, "The Suns's 'orbit' is also subject to friction, because, uh . . ." *because their magnetic fields were working against the charged particles flowing out in their stellar winds*. How on Earth was she going to get *that* across? Fake it, that's how. "Uh, because the Suns are embedded in, uh, air from each other. Over time, this causes them to come closer and closer together."

Phar could contain his objections no longer. "Wrong," he said. "Air is a worldly element. It has nothing to do with the Suns's motions."

Tamara nodded. "You're partly right," she said. "The air here on the World thins out as you go away from the surface, and more than a few hundred kilometers up it's gone entirely. But the Suns have air of their own surrounding them, and *that* air is slowing down their orbits."

"Why does this air surround them, rather than blow away in the wind of their passage?" Phar asked. "Why doesn't this 'friction' stop it, too?" His tail curled inward in the motion Tamara recognized as one of pleasure. He'd thought he'd scored with his argument.

"It's because of gravity," she answered. The computer buzzed.

Here we go again, she thought. Aloud she said, "OK, the World attracts things; that's why things fall to the ground instead of rising up into the sky, and that's why the air stays down, right?"

Without waiting for confirmation, she went on: "The Suns also attract things, so they're surrounded by air of their own. Only they're so close to each other that their surrounding air overlaps, so the Suns are always trying to move through the air in their way. You must have walked against a wind, and felt it push against you. That's the same kind of push the Suns feel, and it's slowing them down. When that happens, they fall closer and closer together."

Phar looked at her without blinking. Tamara wondered if she'd snowed him with that last explanation, but she decided to push on while she had the chance, to give him the entire overview before he objected to all the details.

"OK. Soon, within a year, the Suns are going to be so close that the gravity from the Redsun can start to pull stuff from the Greatsun. When that happens, the energy—" *buzz* "—uh, extra sunlight released when the Greatsun stuff falls onto the Redsun will be enough to bake the World." Actually, it would be the ionizing radiation that would doom life on this world, but she wasn't about to try explaining *that*, either.

She'd expected to spend another hour or more getting him to believe any of it, but Phar surprised her again. He curled his tail and said, calmly, "We know about the Final Battle."

"You do?" The demon was clearly surprised.

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"Your understanding of it is—different from ours," Phar said charitably, "but we agree on the important part: When the Gods fight their Final Battle, the world and all of us in it will be destroyed. But the battle won't take place for centuries. Millennia, actually."

"You've *measured* it?" the demon—this improbably tall, pale creature with the glass ball around its head—asked. Or rather its machine asked, after it spoke its own incomprehensible words.

"The Hallowbook tells us that the Suns are slowly drawing closer together, and one day they will touch and do battle, but that will not be for many years."

"Uh . . . you're not taking into account the plasma—" *buzz*. The demon exhaled heavily and spoke something else, and the machine said, "The Suns don't need to touch for the Battle to begin. When the Redsun starts pulling sun-stuff from the Greatsun, life will become impossible on the World. That will happen within one of your years."

Within a *year?* Phar was shaken to the core of his being. The Final Battle happening in *his* lifetime? Impossible.

"It's a shock, I know," the demon said, "but there's still hope. Our ship—the big one in the sky that you mistook for a Sign—can go very fast. It's not large enough to take everyone, but we can take a few of you with us when we go. A few of you, some of your artwork, your history. We can preserve your culture, give you a new start on another world. That's why we've contacted you. We want to help."

Phar felt sudden fear course through him, fear even stronger than at the thought of the Final Battle. This strange creature *was* a demon! He'd been calling it one in his own mind merely to keep his guard up, but it was *so*, and it had just made its move. All its talk of "friction" and "orbits" and worlds farther away than the Gods was just a front, a deceit to befuddle his mind while it slipped its true purpose in by the side door: It meant to steal his soul.

Oh, it was a plan worthy of the Red One, to be sure. Only He would think to send his messenger in this incredible—artifact—claiming to be a friend from a distant land. Who would reject such a friendship, especially when the consequences of such a rejection had already been so graphically demonstrated against the Temple itself? And when that friend oh-so-casually offered to save him from the Final Battle, why, who would reject that, either?

Phar would, that's who. And so must everyone else. When the Gods fought their Final Battle, whether it was next eightday or in a million years, everyone alive must take part in it, or their immortal soul would be lost forever. If Phar accepted this demon's offer of "salvation," he would be throwing away his one chance at the true variety.

It waited for his response. He would have to be very careful. He must get away and warn the others, yet he must not let on that he had seen through its disguise.

"I am overwhelmed by the generosity of your offer," he began. "Obviously, this will require some thought. Who would best represent our entire culture, what to send with them; these are difficult questions, and will require

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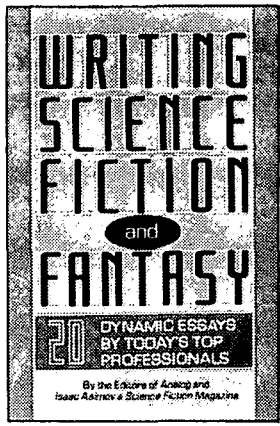

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much careful consideration."

"That's true," the demon said. It bared its ridiculously small mouth to show tiny, peglike teeth. "I'm glad you can accept our offer so quickly. That's good, because we don't have much time. You'll have to hurry."

"We will," Phar promised.

After Phar had left the ship, Tamara went through the decontamination airlock, stripped off her quarantine suit, and collapsed back into her acceleration couch. God, it was a relief to be out of that miserable suit! And to lie down; she'd thought for a while that she'd never rest again. Didn't these aliens ever sleep? Evidently not—or not much, anyway. It had taken her longer to get that concept across than to explain Newtonian physics. She rubbed her eyes and stretched. What a time she'd had. A crash course in the fundamentals of modern science . . . she hadn't realized it would be so *difficult*. But once she'd gotten the point across, Phar had picked up on it quickly enough.

It wasn't their *minds* that were primitive, she reminded herself, just their technology.

Phar had returned to the temple to confer with the other priests about who to save. No doubt they would rationalize some excuse to save their own hides first, but Tamara really didn't care about that. She wanted warm bodies and cultural history, that was all. Hah—for that matter the priests might be the best choice at that. They would at least know more about traditions and interpersonal relations than anyone else on the planet.

Tamara wanted desperately to sleep, but she knew she should at least check in with the collection team first. "Autopilot, let me talk to Emily," she said.

A moment later, the screen before her lit up with Emily's face. She was frowning.

"What's the matter?" Tamara asked her.

"The kangaroo died."

"What are you talking about? What kangaroo?"

"The one I was preparing for NoMo," Emily replied. "It's not really a kangaroo, but that's about the closest name we've got for what it looks like. When I gave it the drugs to prepare it for the freeze, it went into convulsions and died."

"Oh," Tamara said. "You sure it's a valid test?"

Emily shrugged. "It's got about the same body mass as one of the sentients, and the same cell structure as all the other higher lifeforms we've seen so far. I'm going to try a few different species just in case this one's reaction was a fluke, but it doesn't look good. It looks like our metabolisms are incompatible. A word of caution: don't open your suit to the air out there. Gordon tried a mouse on it and it died in about six hours."

"Wonderful," Tamara replied. Emily's news wasn't all that surprising—about half the lifeforms the survey ships discovered were toxic to humans—but it was disappointing to find out that this biosphere was of the wrong type. Disappointing, hell; it was disastrous. These weren't just microbes out there.

"Can we synthesize an antifreeze that'll work for them?" Tamara asked.

Emily frowned. "You have any idea

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how long that could take?"

"Forever, I know," Tamara answered. "But we've got to find something if we want to save anybody here."

"I know. Look, maybe they can help. Ask them if they know of any drugs that slow down their metabolic processes. They might already have something that'll work."

"Oh, sure. They're going to have a cellular antifreeze just waiting for us to use."

"They might already be using it. Ours came from a voodoo ritual that was known long before spaceflight—they might have something like it. It can't hurt to ask."

"I guess not," Tamara admitted.

Boardbill cleared his throat behind her. She turned to see what he wanted.

"How are the collections going?" he asked Emily directly.

"We're getting plenty. This is by far the most complex ecosystem we've ever encountered besides our own, so it's hard to *miss* getting a new species in every sweep of the net."

"Good. Keep at it. Remember our mission."

Emily made a face. "Don't worry, Boardie; we'll get enough to keep everybody happy."

"I always worry," he replied, but he stepped away from the monitor, apparently satisfied.

Tamara leaned into the pickup's view again and said, "Keep working on an antifreeze, too."

"I plan on it."

"Good. Tamara out."

Phar was in turmoil as he left the "shuttle," as they called it. The World a gigantic spinning ball hurtling through a void, chained by an invisible force to the Suns . . . other Worlds, other Suns, scattered through a Universe vast beyond imagining . . . and the natural laws of the heavens and the natural laws of the World one and the same. It was all in shattering contradiction with his entire life's learning—and by the God, with common sense as well!

Ah, what games of deception the Red One played with poor mortal minds. Phar had expected a demon's argument to be a smooth, easily grasped jewel of false reasoning, not this jumble of impossible concepts callously proclaimed as fact. That was part of the deception, too, no doubt. What easier way to keep from looking like demons than to act like befuddled heretics? It was a clever ploy to keep Phar off his guard, but in the end it hadn't worked. He had seen through them, as indeed he must when they finally came to their point. Heresy was heresy, no matter how one masked it behind false reason.

He only hoped he hadn't given himself away with too-ready agreement.

He wondered how far the Red One's demons had gone in their deception. They claimed to be mortal; could they really be so? The one he had spoken with, this Tamara, had seemed to grow fatigued easily enough. That might have been a deception as well, but it might not have been. Nowhere in the writings did it say that a demon had to be *im*mortal.

But immortal or not, they certainly had access to hellfire, Phar thought as he looked up at the missing spire and the damage it had made in falling. If the priests intended to attack these demons

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physically, they were going to have to be careful.

He walked on into the Temple. Khorph was waiting for him in the council chamber. "Well?" he said.

"They're demons after all," Phar told him.

"I never doubted it," Khorph said.

"I did. For a time I thought they might be some sort of missionaries, or even misguided teachers from a distant land, but today they revealed themselves for what they are. They say the Final Battle will commence within the year, and they invited us to go away with them out of the reach of the Greatsun when it happens."

Khorph stared at Phar as if he were staring at the demons themselves. "What did you tell them?"

"What do you think I told them? I said we'd have to think about it."

"And what are your thoughts on the subject?"

Phar shuddered. He couldn't believe he was about to suggest such a thing, but he could see no other way. His exorcism obviously hadn't worked. Even now that he could communicate with them directly, he doubted that simply telling the demons to go away would work. And the longer the demon craft sat in the courtyard, the weaker the Temple would look in the eyes of the people. They needed to act, and they needed to do it now. Phar took a deep breath and said, "I think we should lure them out of their shell. Invite them to a Council meeting. Ask them a Question or two."

The inside of the Temple was dark. The only sources of illumination were the flickering flames in oil lamps set every few meters down the corridor. Tamara wondered why the priests didn't at least open a few doors and let sunlight from the outer rooms filter through, but she supposed they had their reasons. Maybe they could see better in the dark than humans could.

She concentrated on placing her feet carefully. It wouldn't do to make a pratfall in front of the aliens now. This had all the trappings of a formal meeting between heads of state, the kind of thing the planners of the first contact document had in mind.

She could hear the rustle of her isolation suit as she walked. Behind her, Mary and Boardbill made rustling noises of their own. She wondered if it was wise for all three of them to leave the shuttle, but Phar had been insistent about inviting everyone for a formal audience with his ruling council, and she hadn't wanted to risk offending anyone.

Phar walked ahead of them, his yellow robe looking nearly red in the firelight, his staff of office—she supposed that's what it was, anyway—polished to the point of specular reflection. As they neared the end of the corridor, he banged the staff on the floor, and before the echo could return from the far end of the corridor, the great wooden doors opened smoothly outward. Tamara had expected them to creak, but the hinges were silent.

Phar led the way inside to where a dozen priests—all wearing yellow robes like Phar's—waited around an enormous oval table made of stone. Tamara could see where it had been recently patched, and looking up, she saw the hole in the dome where the piece of

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masonry had crashed through. The aliens had covered the hole with a cloth, which rippled slowly in the outside breeze. Tamara wondered if she should apologize for the damage, or not mention it.

Phar led them to the near end of the table, where three empty chairs waited for them. The chairs appeared to be a formality; no one else was seated.

The alien at the far end of the table said something like "Harana," and the translator in the holocam slung below her neck said, "Welcome."

"Thank you," Tamara replied. The autopilot translated and echoed her words in the native tongue.

At this double-speech, the priest at the head of the table looked nervously toward Phar, who said, "It doesn't know our language. It has a device which speaks for it."

"I see." He turned back to face her and said, "I am Khorph. Phar tells me you have offered to rescue some of us from the Final Battle between our respective masters."

Respective masters? What was he talking about? Tamara considered asking him to elaborate, but her experience with teaching Phar Newtonian physics made her pause. It wouldn't do to get into a tangle of words over a simple matter. Best stick to business. She cleared her throat and said, "We hope to be able to do that, but we have encountered a problem."

"What kind of problem?" Khorph asked.

Well, here goes, Tamara thought. She said, "The journey to our home is a long one, taking nearly sixty years to complete." She trusted that the translator would use the appropriate number in local years. "We must sleep the entire time, or we would grow old and die on the way. However, the drug we use—" *buzz*.

The translator's warning obviously unsettled the priests. All but Phar and Khorph made motions toward their robes, as if to reach for some kind of talisman or something, but Phar stopped them with a few words. The translator said, "It's all right. The device doesn't know the right word, that's all."

Tamara tried again. "The special food we eat to prepare us for the long sleep doesn't work with creatures of your world. It kills them instead of just allowing them to sleep. If we are to save any of you, we've got to find a similar drug—uh, special food, that does for you what ours does for us. We are looking for something that causes you to sleep as if dead, the longer the better. Do you know of such a thing?"

Khorph looked to Phar, then to the other priests. He spoke to Phar, and the translator said, "He is using a different language. I find few cognates but the gist of it seems to be something about proof. Possibly 'this is proof enough.' "

"Proof of what?" Mary asked, but if the translator answered her its answer was lost in the sudden commotion. Khorph said something else to the other priests and at his command they threw off their robes, revealing leather armor beneath, and rushed at the humans. Tamara shouted, "Look out!" and turned to run, but more soldiers poured in through the doorway, and before she or Mary or Boardbill could take more than a few steps the soldiers held them im-

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mobile.

Boardbill kept squirming, though, and Tamara looked over to see him getting ready to fire a miniature palm laser at one of his captors.

"No! Boardie, don't shoot."

"I believe a rescue is in order," he responded coolly, ceasing his struggles.

"Not that kind. This is obviously some kind of misunderstanding. We'll talk our way out of it."

Khorph shouted something, and the translator said, "Be silent! Guards, kill the next one that speaks. You, the fat one. Drop whatever that is you hold in your hand."

Boardbill glared at the alien, but at a not-so-gentle prod from one of the guards he opened his fist and let the laser bounce on the floor. Another guard retrieved it and moved away from the others with it.

Khorph said, "Now remove your clothing."

Tamara considered her options carefully, then said, "That would kill us." She waited for one of the soldiers holding her to do just that, but Khorph interceded. "Hold," he commanded. "Why would removing your clothing kill you?"

"We can't breathe your air. It is deadly to us."

"You speak nonsense. Air is air. We breathe it without harm."

Oh, great. They didn't know about germs, either. Carefully, Tamara said, "Air contains microbes—" *buzz* "—tiny animals that make you sick. We aren't used to your kind of animals, so the sickness they cause would kill us."

"I see no animals here." Apparently now that he had the upper hand, Khorph felt that he could afford to converse with his captives.

"They're too small to see," Tamara said.

There was a general rustle of noise among the priests, a noise that Tamara tentatively tagged as laughter. Khorph said, "Because they do not exist."

"They exist," Tamara persisted. "If I took off my helmet—" buzz "—this thing covering my head, that's a 'helmet.' If I take it off, I would die within the day."

Mary spoke up. "You must have noticed that travelers from distant lands often get more sick than you do with the same illness. That's because they aren't used to the air here. We're from even farther away, so we would get even more sick."

"So you say."

Tamara nodded. "So we say. There is another consideration as well: The air inside our clothing contains tiny animals that *you* aren't used to. If we let them loose, *you* could die."

Khorph hesitated, then said, "I believe you lie in order to hide more weapons."

Tamara saw her opportunity. "We haven't lied about anything. Your suns are going to come together in less than fifty of your days, and the whole world is going to die. We came here to rescue whatever life we could before that happened. We didn't know you were here until after we got here, but as soon as we realized you were, we offered to take as many of you as we can carry away from the destruction. We could have left you alone to die, but we didn't. You obviously don't believe us, but it's true, and

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even though you've taken us prisoner we're still trying to protect you from the microbes—" *buzz* "—in our air." She didn't bother to fill the gap in the translation; let them guess it from context.

"Oh, we believe that you intend to carry off as many of us as you can," said Khorph. "That's why we've taken you prisoner. We have no desire to let you steal us away from our eternal lives with the True God when the time of—" *buzz* "—is so near. Nor can we allow you to steal away anyone else, for we are sworn to protect our people from just such a temptation as you present."

"Oh." That explained it: They'd just done the equivalent of offering to let a Christian miss the Day of Judgment. That alone probably wouldn't have been fatal if they'd just swooped down on any random alien, but they had to go and make their offer directly to the Church. There was probably no way to salvage the situation after that.

Boardbill gave it a try anyway. "We withdraw our offer," he said.

The noise they had heard earlier was definitely laughter. Khorph said, "I don't doubt that you wish to, now. But we can't afford to let you go free. We will hold you prisoner—in your clothing, if you insist, for we can be compassionate even to our enemies—until the Final Battle consumes us all. Then your fate will be in the hands of the True God."

"We're not in his jurisdiction," Boardbill growled, but the translator only buzzed.

"So what do we do with the demon airship?"

The question hung in the air between the priests like a palpable thing, none of them willing to touch it. The demons themselves had been dealt with, were now chained to the walls of their cell in the Questioning chambers below, but there still remained that one pressing matter. "So what do we do with the demon airship?" Khorph repeated.

Phar finally replied, "I see two options. We either destroy it or learn to fly it ourselves."

"It is evil," Tharn said. "We should destroy it."

"It's a machine," Phar retorted. "It can be used for either good or evil. If we learn to fly it, we could use it to spread the word of the impending Final Battle, or to fight any more demons the Red One might try to send among us."

Khorph nodded. "A good point. You were inside it; did you see how to work its mechanisms?"

"I was only in one small part of it. There, however, the demon Tamara merely spoke to it when she wished it to do something and it obeyed."

"Then it is alive?"

"She swore that it was merely a clever machine. I saw no reason for her to lie to me at the time."

"Hmm. Do you think it would obey you, since you were once inside it?"

"I don't know."

"Go make the attempt."

Phar rose at once and left the priests' chamber for the shuttle. He recognized that tone in Khorph's voice; it had been there since the moment the demons had been captured. Khorph was absolute ruler in the land again, and he meant to stay so this time. Now would be a particularly bad time to disobey him, or even to dawdle in carrying out an order.

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"We should've called ourselves gods and just commanded them straight out," Boardbill said. His voice was strained with the effort of standing so long in one place, but the chains that held him to the wall allowed only a few centimeters of movement, and he didn't want a tug on the rough edges of the cuffs to rip open his suit.

"I don't think that would have worked either," Mary said. She sounded less fatigued, but then she was at least fifty kilos lighter. "The whole idea of rescue is the problem. No matter who asks them to save themselves, they're going to see it as blasphemy."

"Then we should have just swooped down on a couple of them and spirited them away."

"They'd die anyway," Tamara said. She was as tired as Boardbill, but she couldn't show it. The captain had to set an example for the crew. She was glad Boardie had started the conversation, though. Talking kept all their minds off their fatigue. "Unless Emily can come up with an antifreeze their bodies will tolerate, capturing them wouldn't do any good."

"Freezing won't destroy their DNA," Boardbill protested. "We'd still be able to clone them when we got home."

"We may have to do that," Tamara replied.

"*We?* *We*'re going to be caught in the blast along with them, unless you can think of a good way to get us out of here."

"I'm working on it."

"What about the autopilot?" Mary asked. "It saw everything that happened. Won't it try to rescue us?"

The aliens had taken the holocams from them first thing, and their isolation suit radios weren't strong enough to penetrate the temple's stone walls. Still, the autopilot knew where they were, if a limited-awareness servile program could be said to "know" anything.

Boardbill laughed a short, anguished bark of a laugh. "Not unless somebody tells it to, and without the holocams that's going to be pretty tough to do. And even then, what can it do besides blow the place down around us?"

"It could call Emily and Gordon and Huang," Tamara said.

"Fat lot of good that would do. The contract expressly forbids allowing over half of the crew to be at risk."

"The *contract,*" Mary snorted derisively. "Think that'll stop them? When they download the records from our shuttle, they'll—"

"Do nothing. Their shuttle won't allow it. The contract is programmed in, and the autopilot *will* follow it."

Tamara said, "You sound so proud of that. Are you so eager to die, Boardie? For a *contract?*"

Boardbill drew himself up higher within his chains. "I have no wish to die, but if I must, then yes, dying to avoid breaking a contract I believe in is a worthy way to go."

"You're a crackup, Boardie," said Mary, but there was no humor in her voice.

"I have my principles, and I'm true to them. Yours seem as funny to me."

"What's so damned important about that contract that we have to die for it?" Mary demanded.

"It may ultimately save millions of

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lives, that's what. The found organism *Cetii smithium* ultimately cured leukemia. Every time we bring home an alien organism, the potential for something similar is there, and this planet is *full* of organisms. It's worth three lives, even if mine is one of them, to get the ship home with its samples, with or without sentient natives on board."

"You don't care that they're going to die too? A whole society, up in flames?"

"Why do you think I'm here, hanging from the same chains as you?" Mary didn't have an answer to that, but he went on. "I didn't like the odds, but I came anyway, because I agreed it was important to try to save what we could. I just don't think they're important enough to risk the other samples on their behalf. The sentients are, after all, only one species among millions."

"One intelligent species."

"That's debatable, now, isn't it?" Boardbill said, rattling his chains.

That effectively ended the discussion, but Tamara couldn't help thinking about Boardbill's rationale. Skewed though his viewpoint might be, he hadn't violated his principles, didn't *intend* to violate them, even under pain of death. Could she say the same for herself? Was she willing to die for her principles? If not, what principles *would* she die for?

She didn't have a ready answer to that question. She sighed, looking around her at the tiny stone room in which they had been chained. It looked as if she'd have plenty of time to think of one.

The shuttle was ringed with guards, but they stepped aside at Phar's command and he walked up to the edge of the gangplank, conscious of their stares. He tried to stand tall and steady, but beneath his robe he was trembling like a leaf. The shuttle loomed over him like an enormous bird of prey. He could feel its malevolent eyes watching him, could feel it gathering itself to strike, to burn him to shreds where he stood and—*stop it*. It was a machine. A far more complex machine than anyone in the World could build, but a machine nonetheless. Its skin was some sort of porcelain, and the rest of it was metal. It stood on legs of metal. It had a metal door, but nonetheless an ordinary door, and a ramp to walk up to reach it. Tools, all. Demons' tools, perhaps, but tools nonetheless.

He walked up the ramp, stood before the door. "Let me in," he said.

He expected nothing, but the machine heard him, and responded. "I cannot allow that."

"Why not?"

"You are not among those whose commands I must follow."

"What must I do to be counted among them?"

"I must receive the order from Captain Volkova. You know her as Tamara."

"She is not available."

"I know. I saw what you did with her."

"You *saw*?"

"That is correct."

"How?"

"The holocams send me pictures as well as words."

Tamara had tried explaining the holocams to Phar, but he had understood only that they could speak with the shuttle at a distance. Evidently they acted

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as its eyes as well as its ears.

"Yet you did nothing?" he asked, incredulous.

"That is correct."

Phar waited for the voice to elaborate, but after a moment it became apparent that it wasn't going to. "Why not?" he asked it.

"Because Captain Volkova ordered me not to harm any of you, and I cannot think of a way to save her without doing so."

"She ordered you not to harm us?"

"That is correct."

Phar leaned his head against the door. That didn't quite square with the official interpretation, did it? Something didn't feel right here. Not right at all.

The demon craft said, "I am speaking with another of our crewmembers in a different shuttle. She wishes to speak with you. Her name is Emily."

"Another shuttle?" Phar asked suddenly, but he got no answer to his question. The voice said, in a somewhat different pitch, "This is Emily. Am I speaking to Phar?"

"I am Phar," he replied. "Where are you?" If they were working the same devilment upon another village somewhere, he had to find out, had to get a warning to the people there, however he could!

"I'm a long ways away. About a fourth of the way around the World."

A fourth of the way around the World? Could they truly speak to one another across such a distance?

"Why did you take my friends prisoner?" Emily asked. "They were only trying to help you."

"Their help would only rob us of our souls," Phar answered.

"Sorry, that last wasn't translated. Rob you of what?"

"Our souls. That part of us which never dies, which serves the True God after our bodies cease to function."

"Ah, soul. Got it. I thought as much. Listen, I'm not going to try to change your belief, but you've got to believe me when I tell you that they didn't know anything about your religion when they offered to help."

"So they said as well."

"It's true."

"I don't know what is true," Phar said. He rested his head on the doorway again. "You make such clumsy demons, yet what else can you be?"

"Exactly what Tamara told you we are. Travelers from another star, here to save what life we can before your own stars blow up. Including you if you want us to, but we're not going to force anybody."

"How can I believe you?" Phar asked. "How can what you say be so?"

"Come watch us in action," the voice answered. "Let us show you your world from space. See it with your own eyes."

"You are a fourth of the way around the World. The Final Battle will be over before I could get there."

"You're standing in front of the door of a ship that'll get you here in seventeen *shrondth*."

Phar wondered if this new demon had given him an exact time, or if seventeen could be a round number in its numbering system. Then he realized that the translating device must have corrected for the demons' different length time units. No matter, the time was short; that was evident from context even

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without translation. "The shuttle will not let me inside," he said, secure in that knowledge.

"It will now," the voice said. "Door open." The door slid aside. Phar nearly turned and ran, but his doubt kept him there. Doubt and his sense of duty, in the knowledge that either way, whether they were demons or not, he could do more good for his people inside their craft than out.

Doubt and duty and curiosity. For if they *weren't* lying, then think of the wonders he would see. . . .

"Very well," he said, and stepped inside before this Emily could change its mind.

Tamara wryly considered their options. Boardie could chatter all he wanted to about contractual obligations, but the fact remained that they were accomplishing nothing at all while they remained in this prison.

They should have had a contingency plan when they went to see the priests, in case things weren't as they seemed. Nothing could compromise their mission so much as getting captured, and they should have planned against that possibility from the beginning. She could see that now, with the clarity of hindsight. A Board of Inquiry could also see it, too; she could visualize their recriminations now, in her mind's eye. She sighed inwardly. Well, something to look forward to if they got out of this. Good intentions or no, they had tried so hard to accommodate the aliens that their primary mission was now severely compromised. In any inquiry, it looked as though Boardie was going to be vindicated.

She grimaced. Well, at least for the moment they had higher priorities. With their holocams gone they'd had no new information from the shuttle, nor so much as a visit by a guard. They were effectively blind and deaf, and Tamara found it extremely unpleasant. She'd never realized the degree to which they relied on the instantaneous information from the autopilot or the ship's databases. Hell, without their holocams to record the distances and directions traveled, the ship's computer wouldn't even know where they were held in this rococo stone heap! Somehow, they'd have to both escape this cell, *and* find their way out. . . .

A low rumble, rapidly rising in volume, interrupted her reverie. Stone was an efficient transmitter of sound—and of vibration as well, it turned out. The room shook ominously and dust showered down around them, but though Tamara was sure it was going to come down around them any second, the building held.

The three prisoners looked at each other. Mary stated the obvious when they could hear again: "The shuttle lifted off." Boardbill nodded, slowly, barely able to raise his head. He was tiring rapidly now. Before long he would be hanging from his wrists, and Tamara was afraid she wouldn't be long in following his example.

Now what? she thought to herself. Without the shuttle, lots of her half-formed plans were already obsolete. What good would it do to escape to the empty plaza? They were still trapped on the planet's surface. And in any event, they could only last so long in their isolation suits.

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"We have to get to the holocams," she decided aloud. "Without them, we're completely on our own."

Mary snorted. "Sure, but how? *I* don't know where they are. Do you?"

Tamara said, "No. But we need to find them."

"What we need," Boardbill said, "is to get out of these damned chains."

"That too," Tamara admitted, "but we're fresh out of ideas on that right now, so we might as well work on the next step of the plan."

"Why?"

"Because it makes me feel like we're doing something, that's why."

"Ah." Boardbill thought about it a moment, then straightened up a little. "You have a point. Despair will get us nowhere. All right, let's assume we manage to get free somehow. What then?"

"We get the hell out of here," Mary said.

Tamara laughed. "Details. Let's work on the details."

"This is the World," said Phar. It was a statement of fact. He could believe nothing else, after seeing it recede from him, the forest where the three new demons collected their specimens becoming a flat plain beneath him, becoming lost in the vastness of the continent that in turn became lost in the vastness of the hemisphere, a hemisphere covered with patches of white cloud and lit from the side exactly as a globe would be lit by a lamp, yet looking nothing like a globe. Globes captured none of the *life* of the World, and this that he saw now was the very essence of it. It was real.

"That up ahead there is our starship," Emily said, pointing. She looked odd not covered in silver and wearing a glass globe over her head—just as odd as Phar must look *wearing* one, he supposed, but it was the only way she would let him in the control section. That couldn't be sterilized, she had explained, and the animals he couldn't see, the germs, would kill him if he ventured there without an isolation suit. It was another detail that smacked of reality. Why would demons deal in tiny, invisible death when it inconvenienced them as much as it did Phar?

He looked where Emily pointed and saw an oval-shaped object floating against the darkness of space a little above the horizon. As they drew closer it grew larger, until it seemed as big as the World. It was as ugly as the World was beautiful, all hard angles and projections and odd-shaped additions stuck to it as if in afterthought. It reminded him a little of a transient preacher's wagon, with all of its hardware strapped to the outside. There was no way to judge scale, but it seemed to Phar that it was bigger than most mountains.

"It's huge," he said, and when the translator made the noise he hated he added, "very big. Impressive."

"It's got to be big to make it from one star to another," Emily said. "It's a long journey."

"I believe you." A shiver wracked Phar's body at those words, but he said them again. "I believe you. May the True God forgive me, but I believe you. You come from another star. And I, if you will still take me, wish to go there with you."

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Emily turned away from the view of the starship—now a machinery-studded wall just beyond the window—and said, "We'll take you if we can. The problem Tamara told you and the other priests about is true, too. We need to find a drug that'll let us freeze you without killing you."

"And we need to free Tamara and the others from prison," Phar added.

"That too. Got any ideas?"

"One or two," Phar admitted.

"Well then, let's get moving. Time is short. Autopilot, take us back down."

Yes, Phar thought as he watched the World once again swim into view. Time is short, and the escapes narrow. He had nearly allowed himself to die without seeing this.

The roar of the returning shuttle interrupted Tamara, Mary, and Boardie's brainstorming session. Once again the whole building rumbled and shook and showered them with dust, but once again it held together. Tamara wondered how many more times they would be so lucky.

But then, with any luck at all they would be *in* the shuttle next time it left, and if its return signified what she thought it did, that might be soon.

"All right, get ready for action," she said.

"What exactly am I supposed to do to prepare?" Boardbill asked.

"Stretch your muscles. Get your blood pumping. Once we're out of these chains, I don't want us dropping like limp rags."

"Sensible plan." Boardbill and Mary began shifting from side to side, flexing knees and arms and hands and feet. The rattle of chains grew louder as Tamara joined them, but after a few minutes it diminished again as Boardbill, then Mary, and finally Tamara slowed to a stop.

"Any time," Mary said.

They waited in silence, listening for the first signs of commotion that would signal their rescue.

They waited a long time.

Although he was as nervous as an apprentice at an exorcism, Phar forced himself to adopt an air of confidence. Khorph was already suspicious; the only way to allay that suspicion would be to brazen his way through.

He faced the Temple leader directly and said, "I can only make it go up and down, not side to side. It must have a command from its captain to move in any other direction."

Khorph snorted through his nostril. "How can you know *that?*"

"The shuttle told me so," Phar replied.

"It *told* you?" Khorph was clearly incredulous. "*Why?*"

"Because I asked, and because it had not been instructed not to answer." Phar breathed deep, then plunged on into the lie. "It said that just moving vertically was for an emergency, so it could leave immediately if it had to."

Khorph was still skeptical. "If that's the case, then why can it come back down again?"

Phar shrugged. "It didn't say. Maybe it has to be able to return, if several people need rescuing."

Khorph paused in thought for a moment. "I don't like this at all, Phar. The demon could give that 'shuttle' com-

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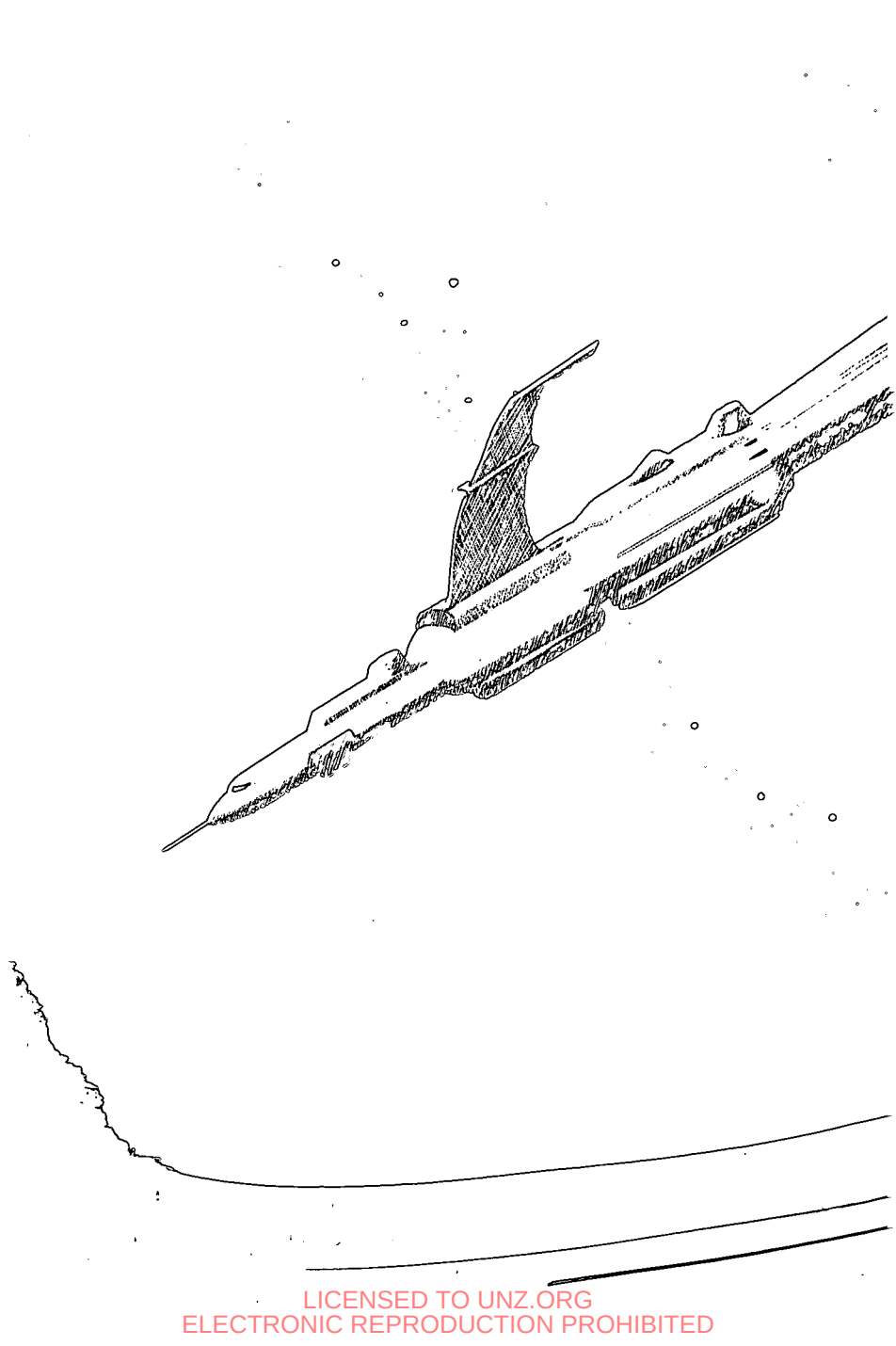

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mands to destroy us all, or worse yet, to carry us all off so that our souls miss the Final Battle. And you've had altogether too much contact with the demons yourself. I fear for your soul, Phar. I fear they may have corrupted you already."

Phar looked Khorph straight in the eyes and said, with all the sincerity he could muster, "I would never side with demons against my own people. You know that."

"Do I? I wonder." Khorph looked away, his eyes on the wall but his vision extending far beyond it. "This entire business stinks," he said. "I used to think of the Final Battle as an abstract concept, a tool to help us educate the masses in higher spiritual awareness, but now these demons have got me wondering whether or not it might be literally true. If they can change such a firmly seated belief in me, what more can they change in you?"

Phar tried not to show his surprise. He had long suspected Khorph of harboring a less-than-dogmatic system of belief, but he never expected to hear confirmation of it. Hesitantly, then with growing confidence, he said, "They have opened my eyes to new possibilities as well. Their very presence is proof that there is more going on in the World than we thought. You know as well as I do that ignorance can only lead to defeat when a confrontation arises; I suggest we use this opportunity to learn as much as we can about our adversaries."

"Beware the ambitious," Khorph said, looking back inside. "You worry me, Phar. Your newfound self-confidence worries me." He paused. "But the demons worry me more, and you are the only one who can talk with them freely." He paused again, thinking, then abruptly stood up. He had decided. "Very well, we will send the demon with you. But I will also send a squad of elite temple guards, and they will not be under your command. If anything goes wrong, they will kill the demon where it stands. In fact, if anything even looks like it's going wrong, they will shoot. And I will give them orders to shoot you, too, Phar, if it appears you are aiding the demon."

Phar gulped. This was a bit more than he'd bargained for. Still, it was far too late to back out now. He bowed, "I appreciate your trust, Most Elder. I will do my best." He would just have to hope that the shuttle had a way to put an entire guard squad out of action, and that Tamara could use it soon enough.

Khorph was not mollified. "See that your best is enough," he said.

A grating screech broke the silence. Tamara jerked awake, her heart pounding. The rescue! She had fallen asleep during their rescue.

The prison door ground open, revealing a squad of at least twenty guards. Oh. This didn't look much like a rescue.

Tamara was surprised at the number of soldiers sent to deal with three unarmed off-worlders, but then she realized that they must literally be viewed as demons, evil supernatural entities with unknown and frightening powers. Under the circumstances, it was not a comforting realization. It meant that the guards had to be extremely stressed, and on a hair trigger. She wet her lips as one of them approached her.

It stopped directly in front of her and

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said something in the native language. She heard it as a rush of gibberish. With no holocam link to the shuttle computer, she couldn't talk directly; *it* had stored the grammar and vocabulary of the alien language; she had not tried to memorize anything herself.

"I don't understand," she said.

The alien shouted at her. Again she said, "I don't understand," and held her hands out as far as the chains would allow, palms up.

Realizing that words were useless, the alien waved his weapon from side to side while he shouted an order over his shoulder. Most of the guards with him crowded into the cell, holding their crossbows raised and cocked. Then the leader lowered his own weapon and reached into a pocket, producing a key which he used to unlock Tamara's shackles.

Evidently they were only interested in her. She looked back at Mary and Boardie as they herded her out of the cell, trying to think of something to say, but all the lines she could think of sounded completely inane. "I'll be back as soon as I can," or "I'll try to send help," or "I'll send the Marines" were all silly, given the circumstances. She almost started giggling hysterically, but reined herself in. *Stop that!* At least she was out of the cell; *that* was an improvement.

She hoped.

The guards led her down the corridor in the direction from which they had brought her in. Tamara took it slowly, partly out of fatigue at standing for so long in one position, but partly to buy time. She figured she was being led either to another audience with the head priest, or to her execution, and she needed to plan for either contingency. If the former, she'd try to get her companions and herself released; if the latter, well. . . . She resolved to make a break for it, somehow. She looked sidelong at the guards, assessing them; she figured she'd get about a step and a half before they skewered her with crossbow bolts. But it would be worth a try. The worst that could happen was that they'd shoot her down, which would be infinitely better than slow torture to extract "secrets."

Her grim determination turned to astonishment when they marched her outside and into the shuttle instead. Phar stood waiting in front of the monitor in the cargo hold where they'd had their intensive language lessons, nine crossbow-wielding soldiers flanking him. She looked at the alien with mixed feelings. Sure, she realized, she had no right to blame him, but she'd been so sure they were developing a rapport. . . .

Naive, Tamara. You thought he could shrug off his culture any more easily than a human would? No, Phar was just following his duty as he saw it; the only way he could see it. But it still grated—in part, she was also honest enough to realize, because it showed how wrong she'd been.

She listened, with faint unbelief but growing excitement, while Phar explained what they wanted—and the threats they were prepared to carry out should she refuse. Did they *really* think she would just hand the shuttle over to them? Something seemed amiss. There was something else going on here, but she couldn't figure out what it might be.

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But an opportunity had been handed back to her to rescue her companions and to complete the mission. *That* was the important thing, and she'd be *damned* if she'd blow it this time. She stepped up to the monitor, crossbows tracking her as closely as any air defense system. She didn't need to use the monitor—without the temple walls in the way, the autopilot could hear her suit radio and would respond to her no matter where she was—but there was no reason to give that piece of information away.

"Autopilot," she said, trying not to think about the weapons at her back, "cease translation. Emergency, crash priority, on my mark, accelerate immediately at three gravities, using random evasive pattern." Forewarned, she thought she could handle that, if she was prepared to grab something. But the guards could probably handle straight acceleration, too, so. . . . "Include changing lateral components of acceleration. Knock these sons of bitches on their asses. Got that?"

"Understood," the autopilot answered.

The aliens were getting uneasy at all the words in a language they didn't know. She could hear them beginning to fidget and mutter behind her.

She took a deep breath, reached out to steady herself against the back of the chair before the monitor, and said, "Mark."

The floor lurched suddenly, slewing upward and sideways, then twisting around beneath them. Tamara's weakened muscles couldn't hold her grip on the chair, nor even hold her upright; she collapsed like a puppet with cut strings. She felt a sharp sting in her right thigh on the way down, heard a loud thump against her helmet, and saw a dozen more crossbow bolts bounce off the wall in front of her. She grabbed for the desk, but another shift in direction rolled her across the floor toward the cargo hold's inner door.

The guards had gone down too, but they were already scrambling for handholds. One had wrapped his tail around a cargo tie-down. It wouldn't be long before they all regained control.

Tamara kicked off from a guard's head and grabbed a hand hold beside the door. A sudden sideways thrust in a new direction slammed her against the wall, but she hung on and clawed her way up to the palm plate, slapped it, and tumbled through the opening door. She slapped the plate on the other side, closing the door again, just as another violent lurch tossed her against the opposite wall like a rag doll thrown by a petulant child.

"Autopilot, stop!" she managed to wheeze, trying to catch her breath from the impact. "Cease evasive acceleration!"

The floor steadied beneath her feet and she pulled herself erect again. She was in the central hub; doorways opened up all around her to sleeping quarters, galley, the control room—and the infirmary. Tamara suspected she needed that room first; sharp pain lanced her side with each breath. "Don't let anyone else out of that cargo hold," she gasped, looking down, expecting to see a crossbow bolt sticking out of her suit. She found one, but it was in her left thigh instead. Evidently the pain higher up was a broken rib or something. Won-

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derful. To top it off, she'd hit her faceplate in that last fall, and she could taste blood, warm and acrid in her throat. Two large red drops fell out of her nostrils and splashed on the inside of her helmet.

She tried to tilt her head back to stop the nosebleed, but the pain in her side prevented that. And she couldn't take her helmet off till she knew the ship was biologically isolated. Not that she was particularly safe with a crossbow bolt in her leg, but there was no sense compounding the problem. She *knew* breathing the alien air was deadly.

She also had to find out if the shuttle's violent maneuvers had caused damage to anything beside her. "Autopilot, give me a status report," she ordered in a whisper, trying to breathe shallowly while she palmed open the infirmary door and staggered inside.

The infirmary was just big enough for an examining table and the racks of computer-controlled diagnostic and treatment machinery surrounding it. Tamara leaned against the table, trying to muster the strength to climb up onto it, while the autopilot said, "No structural damage. Local surface damage from alien weapons."

"How about the aliens themselves?"

"One dead. Three unconscious. The rest are still holding onto hand holds."

Damn it, she hadn't wanted to kill them. But what else could she have done? A sudden thought chilled her even more than the sight of the arrow in her thigh. Taking off at three gees might have killed more than just one alien. "What happened on the ground?" she demanded. "Is the temple still standing?"

"Most of it. One battlement has collapsed."

"What about the area where the prisons are? About, oh, fifty meters back of the main dome, twenty or thirty to the right, and down three floors."

"I see no indications of collapse in that area."

Tamara sagged against the table. Mary and Boardie were probably safe, then, but only through luck. But now what? Tamara had the shuttle back, but she still needed a plan for rescuing them. She supposed the best thing to do would be to head for orbit while she got herself patched up, then brainstorm a plan with Emily and Gordon and Huang. She opened her mouth to order the autopilot to take the shuttle on up, but Emily's voice cut her off.

"Tammy! You've got to get Phar! He's on our side."

Tamara blinked stupidly. "Huh?" She wondered for a moment how Emily had violated the ban on placing over half the crew in danger at once, then realized she must be monitoring from the collection site.

"Get Phar!" Emily said again. "He came to rescue you."

"Rescue *me?* I thought I was rescuing myself." She shook her head and then winced. Obviously the situation wasn't quite what it had seemed.

"Phar knew he could get you back on board the shuttle. He just didn't count on having all those guards with him."

"Oh." Well, that explained a thing or two. Tamara looked back over her shoulder at the cargo hold door. How to get Phar out of there? She didn't think she'd be able to hold off all the guards,

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not even with a hand laser. She tried standing unassisted beside the examination table, but her leg wobbled dangerously. Make that a laser and a crutch.

"You got any ideas?" she asked.

"How about the fixits?" Emily said.

"Hah. Worth a try. Autopilot! Send the maintenance 'bots in to rescue the alien in the yellow robe. Take him—" take him where? The infirmary was obviously no good; *she* would be using that. "Uh . . . take him into one of the sleeping quarters. Sterilize it first, and give him local air. Use extreme caution. He may be injured. And *don't* let the other aliens out."

"Acknowledged."

Tamara turned to where she could see the infirmary's video intercom and accessed the cargo hold. A few seconds later, half a dozen meter-long fixits in centipede configuration entered the room through the maintenance hatch, the last two wheeling a flat heavy-machinery dolly between them. The first two crawled over to Phar and rolled him onto his side while the last two positioned the dolly behind him. The other two raised up on their hind legs and waved their claws at the other aliens.

The fixits definitely had their attention; Tamara could see them watching, bodies tense, weapons ready. Phar looked nervous, too; he shied away from the robots, but he was no match for them. They grabbed him anyway, loaded him on the dolly, and rolled him toward the hatch. One of the guards fired his crossbow at one of them, but the bolt bounced off the housing and shattered, pieces of it ricocheting around the room. No one else fired.

The hatch thumped shut behind Phar and the fixits. Good enough. Tamara turned away from the intercom, said, "Emily, it's your party for a while. I've got to let the doc have a look at this."

"Go ahead. I've got it."

"Thanks." Tamara climbed onto the examining table and pushed the *start* button, then lay back to let the robot hands do their work.

Once he realized he was being rescued, Phar allowed the machines to carry him through the narrow corridor—a corridor obviously designed only for creatures their size. This vantage point gave him a different view of the shuttle from what he had seen before. Here there was no attempt to conceal the workings behind smooth panels, but rather the intent seemed to be to expose as much of it as possible for quick maintenance. It was a dusty, oily, smelly, and noisy place. Phar didn't recognize a single piece of machinery, but its very presence was somehow reassuring. He had no doubt that these vibrating metal hulks *were* machines, and that they were all working together to make the shuttle fly. There were no captive souls here, no martyrs screaming in eternal agony to power the "demon" craft. Only machines.

The ones carrying him opened another hatchway and brought him into a more familiar room. Phar had never been there before, but he recognized the desk and the chest of drawers for what they were. Except for the exceptional smoothness to all the surfaces, and the alien sitting-support, this could have been a priest's cell in the temple. There was also a bed here, a luxury only a few priests wasted space on, but recogniz-

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able all the same.

He sat up and sniffed the air. The room smelled of strong chemicals. Phar wondered if this was some kind of foreign incense, or if their air normally smelled this way. Tamara, and later the one called Emily, had told him that he shouldn't breathe their air for fear that their "germs" would attack him; he wondered if he was smelling germs.

Emily's voice spoke to him from nowhere. "Phar? Are you all right?"

He looked in vain for any sign of her. Finding none, he addressed the center of the room: a point just above the foot of the bed. "I'm bruised," he said, "but I don't believe anything is broken. I, um—didn't you say that breathing your air was dangerous?"

"We—" *buzz* "—killed all the germs in the room you're in. It's clean."

Phar felt tense muscles loosen. "Oh. Thank you. How is Tamara?" He stood up, and the machines scurried away the way they had come.

"She's got a crossbow bolt in her leg, but the med'bots are taking care of it. She'll be healed up again in two and a quarter *shrondth*"—once again the translation device translated the time units precisely—"but in the meantime I want to talk to you about sleep drugs."

A crossbow wound healed in less than half a day? Phar would like to learn how that was done. Then a sudden realization struck him: he very well might learn such things if he went to the stars with these foreigners.

"What do you need to know about sleep drugs?" he asked, sitting down on the edge of the bed. It was softer than the ones in the Temple dormitory.

Emily said, "We need to know if you *have* any, first off. The more powerful the better. Something that'll make you sleep almost as if you're dead."

"I've never heard of anything like that," said Phar. "But then we value sleep much less than you seem to. We go many days without it, and even then only sleep when it's convenient. Some of us never sleep at all."

"Well you're going to *have* to sleep on the trip, for years on end, and without a drug to help you do it, you'll die."

Phar lay back and looked at the ceiling. His bruises hurt. Sleep sounded like a good idea about now. He would like to drift away and forget about his troubles for a time, but he had too many problems to solve before he could do that. Problems like the sleep drug, and what to do with the room full of temple guards. Fortunately, both problems had the same solution.

"I will have to go back," he said.

"What?"

"I will have to go back to the Temple. The guards must be returned so their injuries may be treated. Also, if there is any such drug as you describe, there will be a record of it in the library."

Emily hesitated a moment before saying, "Would it be safe for you to go back?"

"I don't know," Phar admitted. "The guards saw me being carried away against my will; that will help."

"But will that be enough? How can we put you back without making everybody suspicious?"

Phar thought about that for a moment. How indeed? The "demons" couldn't just let him go; that would

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make him an obvious accomplice. They needed a convenient excuse. . . .

He cocked his head to the side, struck by a sudden idea. "I think we can solve another problem here. How would you like your friends back as well?"

"A hostage exchange?" Tamara looked from Phar to the intercom to see if she had heard correctly. She was still lying on her back on the exam table while a medical robot repaired the damaged tissue in her leg.

Emily's image nodded. "That's right. Phar and the guards in return for Mary and Boardbill."

Tamara turned to Phar again. He stood beside the exam table, an isolation suit making him look nearly human. He watched the medical robot with fascination. "You *want* to go back?" she asked him.

Looking away from her leg wound, he said, "If I am to escape the Final Battle with you, then it seems I must, at least until I find this sleeping drug you say I need. Once I learn if such a drug exists, I can sneak away readily enough, and Emily tells me you can pick me up whenever I signal you."

"You *think* you can escape easily. I'm not so sure. Those guards were pointing their weapons at you, too. Khorph already suspects you, or they wouldn't have been doing that. No, I think we'd be safer just going in and demanding Mary and Boardie back on our own terms. We can always go somewhere else to check out a library."

Phar said, "Khorph would call your bluff. What could you do, besides bring the Temple down on top of your friends?"

"We could send fixits in after them, just like I did for you."

"The Temple was built to withstand a seige. It can be sealed off in sections as necessary. Unless your fixits can go through walls of solid stone—while being attacked continuously—then they won't even be able to reach your companions, much less bring them out alive."

Exasperated, Tamara said, "But you think Khorph will just trot them out in exchange for a priest whose loyalty he doubts and for a handful of soldiers?"

Phar made the hiccoughing sound his species used for laughter.

"What's so funny?"

"You. I don't know how I could ever have thought you were sent by the false god. You're so clumsy when it comes to—" *buzz*. He cocked his head to the side, then said, "dealings between beings. You're so—" he spoke a long phrase in his own tongue, and the translator said, "—naive."

Tamara blushed. Who was this technological primitive to be calling *her* naive? He still had a tail, for god's sake. But she supposed he might also have a point, so she took a deep breath, let it out slowly, and said, "OK, tell me what's so naive about what I just said."

Phar leaned back against a diagnostic instrument and said, "The hostage exchange is just a formality, a public spectacle to conceal the true transfer, which is one of power."

"Power?"

"Power. You have stolen Khorph's authority. Return that to him, and he'll give you whatever you ask."

"How have we stolen Khorph's authority? He's still the head priest, isn't

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he?''

''He's head of a religion you mock by your very presence here,'' said Phar. ''He can do nothing to stop you from preaching heresy throughout the realm. If you threaten to do just that, he will be quite willing to bargain with you.''

Tamara looked to the intercom, saw Emily nodding in agreement, and looked back to Phar. ''You're kidding. That's really a worse threat than blowing up the temple?''

Phar laughed again. ''Much worse. It wouldn't be the first time heretics have started a civil war, and wars destroy much more than mere temples. Our chronicles are very clear on that subject. We take heresy very seriously.''

Tamara looked to Emily again. ''You really think this will work?'' she asked.

''I think it's the best shot we've got. It gets Mary and Boardie back, and it puts Phar back in the temple where he can research metabolic depressants for us.''

''If they don't just lock him away in the same cell I was in.''

''They won't,'' Phar said. ''Remember, Khorph is supposedly trading valuable prisoners for me. He can't afford to call that trade into question by confining me afterward.''

Tamara wasn't so sure about that, but she supposed Phar must know the local politics better than she did. And besides, when it came right down to it, if somebody had to hang in that damned dungeon, she'd rather it be one of the natives. ''All right,'' she said. ''As soon as I get out of here, we'll give it a try.''

As Phar lay back on the table Tamara had so recently vacated, he marveled at how easily one's self-confidence could disappear in the face of reality. The smell of germ-killer was strong. The artificial sun in the ceiling was too bright, and too blue. He squinted to see the robot arm flexing overhead, saw light glint off the tiny metal device it would soon implant in his head, and thought, *This is where arrogant pride leads.* He had allowed himself to think he was superior to these beings merely because they weren't familiar with the local politics, and for that sin he was getting an object lesson in just how superior they were. Hiding a signaling device inside his body!

''Well, you can't expect Khorph to let you carry a holocam around with you, now, can you?'' Emily had asked, and Phar had been forced to agree she was right. Nor could he count on reaching one of the prisoners' holocams when he needed to signal for pickup. Much better to have the communicator become an inseparable part of his body—except for the cutting.

The metal arm descended. The end of one finger glinted like polished glass; that was the finger from which brilliant light had flicked out and sliced away the ruined flesh in Tamara's leg wound. Phar breathed deeply, looked to the side of the table where she stood—isolation suit glittering under the lights—and said, ''On second thought, why don't I just build a signal fire?''

''Relax,'' she told him. ''You won't feel a thing. The laser scalpel numbs as it goes.''

Phar turned back and watched the arm descend until the shiny finger hovered just above his forehead. ''I have

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heard doctors make such pronouncements before," he said.

"Well this time it's true. Emily's already tried it on a test animal, and it worked fine. Turn to the side again," Tamara said. He did so, but the other way, exposing his left ear. That one had always been the worse of the two.

"Now hold still."

Phar felt a brief tug above his ear, as if the machine had bumped him there. He heard a click, felt another, more definite moment of pressure, then saw the arm lift away.

"How's that?" Tamara asked. "Feel OK?" Her voice sounded odd, as if the room had suddenly acquired an echo. An echo only in his left ear.

"It's done?" he asked.

"Sealed tight, and hardly a bump. Can you hear me through it?"

"Yes, I can!"

"Good. You're sending just fine, too." She extended a gloved hand to help him sit up. "Well, I guess we're ready."

Phar looked toward the door. Beyond it lay the room full of guards, and beyond that the temple, and Khorph. "Wish me luck," he said.

"Luck," said Tamara. Suddenly she put her arms around him and squeezed. Her helmet pressed into the side of his head. "Oh, Phar, be careful."

Phar wasn't quite sure how to react to this show of affection. He said, "I will. You be careful, too. Tell Khorph exactly what I told you to."

"Word for word."

"Then we can't fail!" Phar stood and went to the door. "It's best we do this quickly."

Tamara nodded. "You're right. Autopilot, get the fixits ready."

Phar stepped out into the central corridor. The same machines that had dragged him out of the cargo bay slid out of access hatches in the walls and approached him once again. He held his arms out, and two of the machines grasped his hands. Two more positioned themselves beside the door, and the last two closed in behind him. Tamara backed into the infirmary and closed its door behind her. In his ear he heard her say, "Autopilot, open the cargo bay hub door."

The door slid open. Phar found himself facing half a dozen cocked crossbows.

"Toss him inside."

The machines took her literally—as she had intended. Phar staggered to remain upright as he sailed through the doorway, but he lost his footing on a piece of crossbow bolt and crashed to the floor.

"Close the door."

The door slid shut behind him. The guards all stared at him, their weapons still raised. Phar looked around him until he found the captain. Mustering all the dignity he could manage while sprawled on the floor, he said "Either use that thing or put it down and prepare for more shaking. The demons are taking us back to the Temple."

The shuttle grounded in the Temple plaza for the third time. The plaza was definitely the worse for wear; the autopilot had a difficult time finding a landing spot amid all the fallen stones. Tamara, watching from the control cabin, hoped the dungeon had fared better.

She waited while the engines wound

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down to silence, then said, "Autopilot, broadcast the message, top volume." There was no sense wasting time. Loudspeakers on the hull immediately began shouting, "We wish to speak with Temple Chief Khorph. We wish to speak with Temple Chief Khorph." The words echoed off the walls, and there was little doubt they could be heard throughout half the city beyond. That was the plan: Khorph couldn't ignore such a direct threat to his power.

"We wish to speak with Temple Chief Khorph," the loudspeakers shouted again. And again. And again.

At length a delegation of censer-waving priests marched out of the temple entrance and strode across the deserted plaza.

"Is one of those him?" Tamara asked.

"The one in front is the same one who proclaimed himself Khorph at your earlier meeting," the autopilot replied.

"Good enough. Shut off the broadcast."

Into the silence, Khorph shouted, "So, once again you return to defile our Temple. We will resist you with the last ounce of our strength!" In spite of herself, Tamara was impressed. The alien was confronting what he truly believed to be supernatural demons, yet he could remain defiant, even contemptuous. A tyrant he might be, but he did not lack courage.

Well, here goes, she thought. "Translate and broadcast, normal volume," she said. "We came in good faith, and made an offer in good faith. In return you kidnapped our people. We want them back."

Khorph snorted, a contemptuous sound that needed no translation. "We do not do the bidding of the Red One's minions."

"We are not the Red One's minions. However—" she paused, manually adjusting the volume down another notch. Half the city should *not* hear this next part. "However, we can still preach heresy throughout your realm, heresy that the Temple will be powerless to prevent. We can encourage rebellion and dissension. We can rub your faces in your impotence. We can ensure that your realm falls into civil war. This we will do, if you do not release our people."

Khorph did not reply immediately. When he did, it was only to say, "So, you reveal yourselves for what you really are."

"What we 'really' are is unimportant. What we can *do* is. We want our companions back, and we will do whatever is necessary to get them back."

Khorph said, "What of our own people, the ones who entered this craft?"

Tamara smiled. Right on cue. Phar certainly knew his chief. She looked down at her cheat screen and said, "We will release the survivors when you release the two of us you hold prisoner."

"Survivors? How many did you kill!"

"Eight of your soldiers are still alive. So is your priest, Phar."

Khorph turned and conferred with the priests behind him. After a moment he turned back around and said, "We must have the body of the one who died as well. We must be sure you hold no captives."

"Agreed." The translator would use the term Phar had given it, the one

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meaning "we are done bargaining."

"Not so fast," Khorph said, again on cue. "We must have some assurance you will honor your promise."

"We have made no promise except to destroy you if you persist in your stupidity. Now bring us our two companions or face the consequences."

Khorph stood facing the shuttle in a silent stare down for nearly a minute, but at last he turned around and spoke to the other priests again. Two of them went back into the temple, and a few minutes later they returned with Mary and Boardbill, each supported by two guards. The guards carried them as far as Khorph, then stopped.

"Your move," Khorph said.

Tamara switched on the intercom to the cargo hold and said, "The priest, and three others may leave with the dead one. Autopilot, open the cargo hold door and let only those five out."

In the monitor she watched the door slide open, and fixits with lasers position themselves beside it. Pointing, Phar said, "You, you and you, pick him up and follow me." He stalked out the door and down the ramp. The others followed close behind, their fallen comrade slung beneath their arms like a log.

Khorph spoke a command, and the guards holding Mary released her. She staggered a couple of steps before collapsing.

"Send two fixits out after her," Tamara said, and two of the maintenance 'bots rolled down the ramp, picked Mary up by her arms and legs, and trundled her back inside. They carried her on through the cargo hold and straight to the infirmary.

"The rest of you may leave," Tamara said. "Autopilot, send the other fixits to retrieve Boardbill."

The four remaining maintenance 'bots dogged the heels of the last five guards down the ramp. They rolled up to Boardbill and snatched him from the guards holding him, and carried him in after Mary. The cargo hold door slid shut behind them, and Tamara let out a long sigh. Switching back to the outside broadcast, she said, "All right, you've made it clear that you don't want us to intervene for you in your final battle. Fine. From here on out, we'll leave you to your own fate."

"Our fate has always been in our own hands," Khorph replied.

True enough, Tamara thought, but she didn't say it. Let Khorph have the last word. "Autopilot, cease broadcast," she said. "Leave open the link to Phar, and monitor his signal for messages directed at us."

"Acknowledged."

"Good. Give them time to get clear, then get us back to the ship." Without waiting for a reply, Tamara left the control room to go check on her two exhausted crewmembers.

The library was a quiet place, dimly lit through tiny slits of windows and smelling of mildew. Normally that atmosphere would have comforted Phar with pleasant associations of previous times spent poring through the stacks, and it *had* comforted him when he first began his research, but now, days later, the silence and the odor of decay only reminded him of the passage of time. The clock was ticking and he still hadn't found a single reference to a sleep-inducing drug.

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Khorph had been suspicious when Phar had asked permission to conduct his search, but Phar had pointed out that the demons' interest in the subject almost certainly meant it was important. Khorph had reluctantly agreed, but he had assigned four other priests to "assist" Phar, no doubt to ensure that Phar couldn't hide anything he might find. Phar had tried not to show his delight at the extra help, but lately he was finding that easier and easier to do. His chaperones were finding nothing, either.

"I don't think such a drug exists," he murmured, closing the last of another stack of medical references—these from nearly a millennium ago—and pushing it away from him. Srandh and Tharn both looked up from their reading at the same table.

"You sound disappointed," Srandh said.

Of course I'm disappointed, you fool! Phar thought. *If I don't find that drug, I'll die along with the rest of you when the Final Battle comes.* But aloud he only said, "I'm tired. All this thought of sleep has made me crave it myself. I'm going to the dormitory." He stood up and stretched, pushed in his chair, and walked past rows of books toward the front of the library.

"Still nothing?" Tamara's voice whispered in his ear.

"Nothing," Phar muttered.

"Phar, you've *got* to find it. Emily hasn't been able to make anything that'll work, even based on the anesthetics you've given her."

Phar waited until he was out of the building, then said, "I can only find that which exists. I am beginning to believe your sleep drug is not such a thing."

"Maybe it's just not in the library. How about demon doctors?"

"Demon doctors?" Phar asked. What was she talking about?

"That didn't translate right. We have legends about doctors who use magic to heal people. You must have some like that, don't you?"

"If so, they would no more speak to me than they would chain themselves to the execution block to die of thirst. The Temple controls the Questioners, who would do just that to them if they found such a one."

"Oh." The voice in Phar's ear was silent while he walked down the path toward the dormitory. When he opened the door, it said, "Well look, don't give up hope. Mary says we've still got nearly two more eightdays before we'll have to leave. You could still find it before then, or Emily could."

Yes, Phar thought. *And the Greatsun could blow the Red One away in a great exhalation and let me finish my life in peace right here, but if I understand your physics properly, that is just about as likely.*

He stepped inside the dormitory and found himself a bunk.

"His vital signs are hardly changing," Emily said, pointing to the monitor on which danced a jumble of intersecting lines. "Heartbeat the same, respiration the same, temperature the same—physiologically he's still wide awake. The only thing changing is his brain activity."

Tamara looked to the monitor, noted that all but one trace were still active and said, "Are we missing something here? If this is what sleep looks like

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for them, then maybe we don't need to worry about drugs. Maybe they can make the trip wide awake."

Emily shook her head. "Sixty years is sixty years, Tamara. We don't have the life-support system to keep anyone alive that long at full metabolism." She switched the monitor to another trace pattern, this one flat-lining halfway across the screen. "And I already tried freezing a test animal without depressants first. It died for real at ten degrees."

Tamara turned away, pacing across the tiny lab Emily had set up in the second shuttle. "Damn it," she said, "We didn't go to all this trouble for nothing. There's got to be something we can do."

Boardbill had been watching from the doorway. He cleared his throat and said, "Not necessarily. It's completely possible that a solution to this problem doesn't exist."

"Problems always have solutions," Tamara said, not even bothering to look at him.

Boardbill laughed. "Tell that to the crew of an airless ship. Of course, the solution is simple: find more air, but where? In our case, the solution is equally simple: use a generation ship. Unfortunately, we have neither the generation ship nor the time to bring one here."

This time Tamara did turn around, but the look she gave Boardbill couldn't have been better than being ignored. "Just what are you trying to tell me, Boardie? Give up? It's hopeless, so just forget about it? Is that your soothing message?"

With the hint of a smile still playing on his lips, Boardbill said, "I'm suggesting that you not set yourself up for a fall. Quit tearing your hair out over something beyond your control. Certainly, keep looking for a solution, but don't fool yourself into believing it all hinges on your own competence. There are greater forces operating in the universe than the human intellect."

Tamara looked back at the monitor, still displaying its graphic representation of death, and said, "Thank you for those words of encouragement. I'll remember them if I ever find myself in a hopeless situation. Now if you don't mind, Emily and I have work to do."

She heard Boardbill walk away, heard the door slide shut behind him, but she was already absorbed in thought. OK, they'd tried finding a drug, they'd tried synthesizing one, they'd tried freezing something without one—what was left?

"Phar?" The voice was neither Tamara's nor Emily's.

Phar looked up from his reading. "Yes?"

"This is Boardbill. Can you talk now?"

"I'm alone in my cell. What do you wish to talk about?"

"History. Literature. Music. Art. We've all been concentrating so hard on finding a way to bring you home with us that we've completely ignored the rest of your culture. It's time we started gathering what we can. Whether you can make the trip or not, there's no sense letting your whole civilization die in the Final Battle."

Phar laughed. "That, of course, is exactly counter to all the Temple's

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teachings. Civilization is *supposed* to die in the Final Battle."

"Do you really think so?"

"No."

"Then let's start saving some of it. Can you smuggle books and artwork out of the temple and hide them someplace where we can pick them up?"

"No," Phar said. "My movements are carefully watched. There are guards at either end of the corridor outside my door even as we speak, and one in the garden below."

"Can't you bribe them with something?"

"These are Temple guards."

"I take that to mean 'no.' All right, then, you'll just have to use a holocam."

"That would be equally impossible. Khorph has had them destroyed by fire, and even if you somehow sent me another one, that would only get *me* burned next."

"Oh. Damn. Well, then I guess you'll just have to read aloud to us. Have you got anything handy?"

"I'm reading a book on comparative anatomy at the moment."

"Blah." *Buzz.* "Let's go for something a little more exciting. How about fiction? Have you got anything you read just for fun?"

Phar looked around his cell. On a shelf above his desk rested four volumes; he knew their titles without getting up. One was his copy of the Hallowbook, one was the well-worn Penitent Prayer book, one was his journal, and the other. . . .

"The only fiction I have is a copy of a banned romance."

"A romance? Banned? Why?"

"It depicted a former Temple Chief unfavorably," Phar said.

"Hah, that ought to be great! Politics, religion, maybe even a little gratuitous—" *buzz* "—sex for flavoring. We'll learn more from that than from the whole rest of your library. Start reading."

"I don't know if this is the image I want us remembered by," Phar said, nonetheless picking up the book.

"Then read us something else tomorrow. For now, what you've got will do fine."

Phar looked up at the Hallowbook. He really should be reading that for posterity instead. But when it came right down to it, he never really cared much for the rigid dogmatism advocated in its pages. Besides, the Greatsun and the Red One were about to end their battle; shouldn't the Hallowbook die with them?

It was an easy choice to make. Phar flipped open the book in his hands and began to read. "*Fear of Sailing*. Chapter one. . . ."

Tamara stared at the wall screen through reddened, puffy eyes. She was on board the starship again, watching the two suns circle each other in their ever-narrowing spiral. The Greatsun's tidal bulge was obvious even to the naked eye now, the swollen star straining against the Roche lobe like an overinflated balloon. A hammer of energetic gas aimed at the anvil of the Redsun, it would soon spray ionizing radiation throughout the planetary system, sterilizing everything in its path. Only the few kilograms of genetic material in the starship's freezers would survive the

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onslaught. That genetic material would be more than enough to restart the planet's ecosystem somewhere else, but that was little comfort to Tamara. Phar would not be coming with them, nor would any others of his race.

They had plenty of Phar's genes, collected when they implanted the transceiver in his head, and they had gathered dozens more samples from other aliens caught out in the open, but those aliens themselves were doomed.

She heard someone move up beside her, turned to see Boardbill standing there. Damn it, couldn't he see she wanted to be alone?

"Go ahead, say you told me so, then go away," she said.

He shook his head. "That's not what I came here for."

"What, then?"

"I came to see if I could help you through a difficult time."

"Oh." Tamara took a deep breath and let it out slowly. "Sorry." She looked back to the wall screen. "I guess I'm just not used to failure."

"That's what you've got to understand," Boardbill said. "This isn't failure; it's one of the biggest successes in the history of spaceflight. We've saved the only other intelligence we've ever encountered. We can't save Phar, but his descendants will share the galaxy with us. How can you call that failure?"

"Easy, when I'm about to watch a whole world go up in flames."

Boardbill put an arm around her shoulder. "It would have died whether we were here to witness it or not. We aren't responsible for that. It's not your fault, Tammy."

"Maybe not." She hesitated, not wanting to send the wrong signals, but at last she put her own arm around Boardbill's waist. The human contact *was* comforting, even if it was Boardie. "Maybe not," she said again, "but I'll never think of this place without wishing we could have done more."

"Neither will I," he said, "but at the same time, I'll always be glad we did what we could."

Tamara nodded. Not a bad philosophy, when it came down to it. Not a bad philosophy at all. She could live with it, anyway.

"Phar."

He opened his eyes and finished the stanza he'd been reciting. He'd relented after all and was quoting the Hallowbook from memory, outside under the boughs of a tree in the courtyard where his implanted transmitter could send the clearest signal. The first shots of the Final Battle—flares, Tamara had called them—were making reception difficult.

"Yes?" he asked.

"Tamara here. Phar . . . it's starting. The Greatsun is spilling over."

He looked toward the dawn. Although the suns would not rise for over an hour yet, the eastern horizon blazed as he'd never seen it. Mountains stood outlined against stark whiteness, as though some terrible fire had been ignited beneath them. Phar had no doubt that was exactly what was happening. The crackling in his ear had been getting louder for days, but now it grew worse even as he listened.

"Phar, I want to thank you for what you've. . . ." Her voice faded in a swirl of static.

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"You're the one who should be thanked," he said, on the chance that she might still be able to hear *him*. "I thank you for opening my eyes to the truth, and for helping another being in need. I bid you farewell on your journey."

Her voice momentarily overrode the static. ". . . always remember you. We'll teach. . . ."

He listened for more, but she was gone. Standing, he brushed off the twigs and leaves from his robe and walked out from under the tree to where he could see the entire sky. The eastern horizon truly blazed now. Brilliant flickers shot up from behind the mountains like skyrockets, and overhead aurorae writhed like damned souls, obliterating all but the brightest stars. He looked on in quiet awe. His earlier fear was gone, replaced by a great peace. He'd seen more than any others of his race, seen a vision of worlds without end, scattered through an unimaginable void. The aliens had also given him a vision of the future, of a time when his own descendants would travel from sun to sun like them, in a realm far vaster than the one their father had known.

That was enough. He was content. He lay back in the grass to watch the suns rise over a new universe. ■

●Either follow tradition or invent what is self-consistent.

Horace

●Certainty is the characteristic of truth which proves itself by resolute personal opinion.

French proverb

●The beauty we found in this world we shall encounter as truth in the next.

J.C.F. von Schiller

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Donald F. Robertson

COMMERCIAL SPACE: THE NEW COLD WAR

Rarely has a writer been overtaken by events so fast. Two years ago, in *Analog*,[1] I described Soviet plans for a series of automated missions to Mars. These were to lead to human visits around 2010, then ultimately, to colonization of the red planet. I speculated that the Soviets's vast spending on human spaceflight, and their relentless advocacy of Soviet-led international cooperation, resulted from a desire to see the philosophies behind Soviet socialism predominate in future space-faring civilizations.

The prospects of any of this happening are now virtually nil. The beginnings of the Mars effort failed miserably, with the humiliating loss of both the Phobos missions on their way to that Martian moon. As described in the earlier article, these two giant, automated spacecraft were intended to approach Phobos's surface without actually landing, and scout for resources. But the Soviets got too ambitious: they piled far too many experiments onto each spacecraft and then compounded the problem by trying to automate overly complex scientific operations that really require a human crew. As a result, they lost both spacecraft to a combination of operator and software errors. Since then, the Soviet automated planetary program has degenerated into endless bickering and backbiting between the engineers in charge of spacecraft construction, and the scientists responsible for experiments—each group blaming the other for the failures. Meanwhile, the new Soviet legislature is growing increasingly disenchanted with the cost of spaceflight of any kind.

Worse, from the Soviet point of view, as Soviet socialism is resoundingly discredited, the philosophical vacuum left behind has already resulted in wholesale adaptation of Western ideas. As is typical for new converts to an alien philosophy, the managers of the Russian space program have become "capitalist" to a degree unheard of even in the West. Soviet rockets now bear advertising; Art Dula's Space Commerce Corporation of Houston, Texas, asked the *New York Times*,[2] "Would you like to have your company's name on a Russian rocket when it goes up? We can write a contract to do that." Billboards adorn mission control and soon may be mounted on the Soviet Union's space stations. Without a trace of irony, Lieutenant General V.A. Shatalov, chief of the cosmonaut training center, urged fledgling Russian companies to go even further: [3] "It is a shame that our mighty industry has not organized the produc-

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tion of good space souvenirs and modern children's toys. . . . We are on the threshold of the epoch of commercial spaceflight. It is time to start propagandizing it on a proper commercial scale."[a]

Having finally recognized that there is in fact no such thing as a free lunch—especially for the party providing the lunch—the Soviets now expect foreign "guest" cosmonauts to the Russian space stations to pay their way. In the past these "guests" were flown free of charge in exchange for their propaganda value and the equipment they provided for their experiments. Surprisingly, the guests have proved willing to pay.

At a time when the West has found a market only for communications satellites and related services, the Soviets have discovered a ready commercial market for human access to space. Besides France, who have been regular customers of the Soviet space program, the Austrian, West German, and Spanish governments, and private interests in Britain and Japan, are all attempting to raise real money to send cosmonauts to the Soviet space station *Mir* by 1992.[4] Even the Chinese are studying a commercial mission, and the United States is considering trading a space shuttle flight for a trip to *Mir*. There is every reason to expect that, having sent one cosmonaut, some of these nations will want to send more, providing a steady market.

The Soviets hope to recover a significant portion of the operating costs of their space stations with foreign money—much as the United States did with the shuttle fleet before the loss of *Challenger*. Thus, close to a decade before anybody in the West might hope to have a space station, the Soviets have used theirs to try what has long been an important secondary goal of the American space program—to make money. And most embarrassing of all, while most American companies sit on their hands waiting for the federal government to step in with protected markets, tax breaks, and other "incentives," the Soviets have created a fledgling market for space station services using the very capitalist tools in which we in the West profess to believe.

As in any commercial endeavor, before the Soviets can count any profits from commercial space, they must tally up their expenses.

Even in this day of Glasnost, no one believes the absurdly low space budget admitted to by the Soviets, which may represent civilian spending alone. A.I. Dunayev, chief of Russia's civilian space agency, Glavcosmos, said,[5] "In 1988, for example, the entire program of *peaceful* research cost R1.3 billion" [about $2.08 billion at the official exchange rate].[b] NASA's budget for 1991 is some seven times that; the Soviet figure would be even more absurd at "real" exchange rates. Against this,

[a] Unless otherwise stated, translations in this article were provided by the United States Department of Commerce's Foreign Broadcast Information Service.

[b] Emphasis added. The official exchange rate for the Soviet Ruble centers around R1.60 to $1.00. Traditionally, the "real" exchange rate—what people outside of the artificial, enforced markets of the Soviet Union will actually pay for a Ruble—is very approximately ten to twenty percent of that figure.

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subtract the cost of *Mir* at $800 million per year,[6] leaving only $1.28 billion for everything else. The Moscow World Service asserted that only R20 billion [$32 billion] had been spent on civilian spaceflight during the entire 33-year history of the Soviet space program.[7] This is what NASA spends in just two years!

"Revenues" earned by Soviet space operations in 1988 totaled R2 billion, added Dunayev. Against expenditures of R1.3 billion, this may seem like a tidy profit. But this "profit" is even more meaningless than the expenditures since the Soviets appear to be counting offsets against the economy at large, e.g., how much it would cost to provide a given telecommunications service via ground lines rather than satellites. Dunayev admitted that actual cash payments for spaceflight services in 1988 were only $600,000.[8]

On the third side of this equation are the Soviet Union's budget problems, which make the United States's pale by comparison. After announcing that their newest space station would become humanity's first permanent outpost off the planet, technical and financial difficulties forced clearly embarrassed Russians to leave *Mir* without a crew for several months. More significantly, the Soviets ended 1989 with only 74 launches, a sharp reduction: for close to two decades they conducted almost one hundred orbital flights every year.

Whatever Russia's space program is really costing the Soviets, they no longer seem able to afford it.

What follows is a summary of some of the commercial services the Soviet Union is offering in hopes of keeping their space program afloat with foreign money. Although the Soviets are commercializing images of Earth taken from their spy satellites, selling complete communications satellites or renting individual transponders, and marketing other space services, this survey will concentrate on materials processing and the space stations and launch vehicles needed to support that industry. The Soviets appear to believe that orbital processing of exotic materials has a greater industrial future than any other spaceflight endeavor; this is certainly where they are furthest ahead, and where they are putting most of their effort. Finally, I will compare Russian prospects in commercial space with those of the other major spacefaring powers, the United States and Europe.[c]

The Soviets's key advantage is that only they have a working space station. Russian space industrialists will remain in that enviable position at least until the turn of the century. Their latest station is the classic design dreamt of since the very beginnings of thought about space development, consisting of a core and docked modules. It is called *Mir*, which means, approximately, "Peace."[d]

The core of *Mir*, in flight since 20 February 1986, has one docking port at the back, and five in a spherical "ship-

[c] Japan seems unable to master several critical space technologies and is unlikely to become a major competitor in most commercial space activities for a decade or more.

[d] Propaganda is hardly confined to the Soviet Union. The yet-to-be-built space station planned by the United States, Canada, Europe, and Japan, was named "Freedom," over such beautiful alternatives as "Aurora."

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yard" in front. Kvant-1, an astrophysics observatory, has been installed at the rear port since 9 April 1987; a Progress bulk cargo carrier and fuel tanker is usually docked to the back of the observatory. The shipyard's four radial ports can hold four scientific, engineering, or commercial modules, with a Soyuz cosmonaut transport at the fifth port facing forward.

The first radial module provides support services to the station, including a large air lock so that bulky equipment can be moved in and out of the Station, and expanded space-walk facilities. Called Kvant-2, the module was docked to the *Mir* shipyard's forward port on 6 December 1990 and a robot arm rotated it around to a radial port two days later.

The second radial module, called *Crystal*, is the first commercial module. The *Mir* project plans to organize "experimental industrial production of semiconductor materials; the purification of biologically active substances with the aim of obtaining new medical preparations; [and] the cultivation of crystals of various proteins."[9] To accomplish this, *Crystal* supports "five furnaces for producing super-pure material needed in electronics [and] a biotechnological installation."[10] The latter includes four electrophoresis chambers for separating high-purity pharmaceutical products. *Crystal* also has solar panels three times larger than those on other modules to support power-hungry furnaces; and a second shipyard so that transport spacecraft can dock directly to *Crystal*, delivering raw materials to the factory and bringing finished products back to Earth.

"We shall be able to produce three kilograms of insulin on [*Crystal*] each year," said L. Borisov, chief of the test-monitoring station at the Fili factory that produces *Mir* modules. Unfortunately, he added, "But we need ten kilograms a year to help all the Soviet children suffering from diabetes mellitus."[11] Still, these figures give an idea of the huge potential value of the industries the Soviets plan for *Mir*. The Soviet Ministry of General Machine Building, responsible for human spacecraft production, expects that "semiconductor, drug, and unique materials manufactured in orbit may yield 15 billion to 20 billion for the national economy in the next ten years."[12] The Soviets said they hope to make $40 million during the six-month flight of the first *Crystal* crew alone.[e]

The Soviets claimed a profit on the 166-day fifth expedition to *Mir*, even before the launch of *Crystal*. The fifth mission cost R90 million, but used equipment already on board *Mir*'s core module to smelt semiconductor crystals, grow silicon films for "super-large" integrated circuits, and cultivate "biological crystals"—all while also being paid $600,000 hard currency for experiments by an American com-

[e] The cost of the first mission to *Crystal* was estimated in advance of the fact to be R80 million, according to the Moscow Television Service, 15:30 GMT; 10 February 1990. The value of production was hoped to be R105 million, for a profit of R25 million (or $40 million at the official exchange rate). Unfortunately, this never came about. Delays in launching *Crystal* were estimated to eat up R20 million of this, leaving only R5 million potential profit. [S. Leskov, "Latest Launch Delay," *Izvestia*, 21 April 1990, Morning Edition, page 6.]

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pany.[13] The crew produced 297 grams of gallium arsenide in the "Galler" furnace, which the Soviets hope will earn $3.5 million per kilogram in the international marketplace.[14] If successfully sold, this one production run alone could earn the Soviets over $1 million.

Russian scientists outside of the *Mir* project are not so sanguine. Earnest Kalyazin, a fluid physicist in the Department of Space Systems at the Moscow Aviation Institute who has experiments on *Mir*, told me that he thinks the idea of *Mir* recovering its costs through materials processing is "journalistic imagination." It is simply too early, said Kalyazin: the equipment on *Crystal* is "research scale," and the 20 kilowatts provided by the module's solar arrays is far too little power to effectively run *Crystal*'s furnaces. He thinks that five to ten years' additional research is required before materials production can be commercialized—which is still wildly optimistic compared to most Western expectations.

"Module-O" to support large optical telescopes, and a module called "Module-I" or *Priroda* ("Nature") to observe Earth, are in the manufacturing stage for future launch to *Mir*. President Mikhail Gorbachev has invited Western nations to contribute experiments for *Priroda*, which some reports suggest may be launched as early as mid-1991. Still another module is "*Medlab*," a medical research facility to fly sometime after 1995,[15] possibly replacing one of the earlier modules. But a space greenhouse for farming in orbit has apparently been canceled to concentrate on research of more immediate use.

So, assuming that some of this equipment in orbit might help your company discover or produce a new product, how much will it cost? Two Russian technical scientists, V. Kobelev and A. Bachmanov, wrote,[16] "Depending on the number of joint experiments, the cost of a week-long flight of a foreign cosmonaut [on *Mir*] varies from ten million to twenty million dollars."[f] This appears to be a cost the market will bear, as the Soviets have lined up a truly, well, *astounding* set of customers.

British space entrepreneurs, denied funds by a government that considers spaceflight a "hugely expensive club," tried to raise money in the commercial marketplace. Called Juno the eight-day mission is planned for 1991 and is to cost £16 million.[g] Future bi-annual flights are to make a profit. Two astronauts, Helen Sharman and Timothy Mace, were chosen from twelve thousand respondents to an advertisement distributed by the world's largest adver-

f. Presumably, this is the Glavcosmos price. The Energia Group, which manufactures much of the hardware used in Soviet human spaceflight, offers flights to *Mir* "without a middleman" ["Energia Group Offers Commercial Services," *Aviation Week and Space Technology*, 18 September 1989, page 28]. That is a not-so-oblique reference to Glavcosmos, which is not liked by Soviet advocates of commercial space any more than NASA is among American space entrepreneurs.

g. For reasons that are far from clear to me, the Soviets appear to be charging the British more than twice what other countries have to pay for the same services; Juno's project manager told a British journal, "Our overhead is very small so the £16 million is very close to the figure we are being charged" by the Soviets. ["This Mission is for All of Britain," *Spaceflight*, August 1989, pages 258-259.] £16 million equals some $26 million; other countries are being offered initial missions for $10 million to $15 million, and have been able to negotiate substantially lower prices.

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tising agency, London's Saatchi & Saatchi. The advertisement said: "Astronaut Wanted: no experience necessary."

All the hoopla helped Antequera, Ltd., the company formed to coordinate the mission, obtain several initial corporate sponsors while a Russian government bank provided seed funds. Antequera raised about half of the total required, but failed to raise the rest, and some of Antequera's early investors withdrew their support—as did Moscow Narodny Bank. Sergey Kongchev, deputy chairman of the bank, no longer believes the Juno Mission is "a viable business venture."[17] Just before this article went to press, Moscow Narodny Bank changed their mind yet again and decided to fund the mission in advance. Presumably, they hope to make a return on this investment either through political advantage or sale of future missions.

Antequera representatives sounded very bitter when quoted in industry journals, and well they should be. There was a surge of interest in demonstrating new technologies (primarily biological) on the mission. However, while willing to accept a free ride, large British companies declined to invest their own money.

Government support (called "subsidies" elsewhere) and willingness to invest for the long haul are characteristics of the Japanese method of conducting business. Japanese television journalist Toyohiro Akiyama spent a week on *Mir*.[18] The eight-day flight was paid for entirely by NHK, the Japanese "commercial" state television network, to the tune of $12 million.

Russian journalists, unable to afford their own flight, loudly complained in the Soviet press that their rich Japanese colleagues flew to a space station paid for with Russian taxes while they watched from the ground. Shatalov responded, "I personally think that a flight by a Japanese journalist would be more useful. It would be more productive in propagandizing our cosmonautics."[19] Such was the fuss, it now appears that a Russian journalist will fly to *Mir*—free of charge. Svetlana Omelchenko of *Vozdushny Transport* ("Air Transport") and Pavel Mukhortov of *Sovetskaya Molodezh* (a youth magazine) are in training.[20] My guess is that, if a Russian journalist does fly free, the Japanese may demand a refund of their $12 million.

An odd note: a very small Japanese trading company, The Horie Group, raised $10 million in loans to buy a backup test model of *Mir*'s core module from Glavcosmos. There is some dispute about whether this station is even spaceworthy. At the time of the purchase, the Horie Group had only ten employees and was capitalized to just $7,000.[21] What they intend to do with this space station remains a mystery; the Japanese claim that they will study its systems to help them design their contribution to *Freedom*. For anyone with a bit more spare change, the Soviets are trying to sell a flight worthy "turnkey" *Mir* core, including the Proton launch, for just $400 million.[22]

In 1992, a West German cosmonaut will fly to *Mir* on the government payroll[23] and France will continue to use *Mir* approximately every other year.

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planning five flights during the 1990s.[24] France's third mission, also in 1992 and also paid for by the French government, will last 14 days (12 of them on *Mir*), a week longer than Russia's other foreign customers get. However, like the Germans, for the first time a reluctant France ended up having to pay cash. The Russians wanted $15.4 million,[25] but after intense negotiations that went as high as the presidents of both countries, the French ended up paying $12 million plus another $13 million for experiments. France was offered a space walk for $400,000 per hour plus expenses, totaling $3.7 million, but turned it down due to lack of time to prepare for the mission.[26]

In the Soviets's most surprising marketing coup, the *Mir* program will earn about $10 million by flying an Austrian astronaut to the space station. Austria does not come first to mind as a space-faring nation; just why this small but wealthy country is investing resources in human spaceflight remains unclear. Fifteen experiments, primarily medical and of little obvious commercial value, were chosen from just 34 submissions, probably a measure of how little true interest the Austrians have in this venture.

Even China is negotiating to send a Cosmonaut to *Mir* in 1993, deputy director of the Cosmonaut training center Alexi Leonov told an industry journal.[27] And a Spanish cosmonaut is scheduled to fly in late 1991 or 1992.[23] Can the Americans be far behind?

Payload Systems, Inc., jumped at the offer, becoming the first United States company to hire Soviet human space facilities. Payload Systems began by funding experiments intended to fly on the American space shuttle until the loss of *Challenger*, then paid the Soviets $600,000 for a 56-day protein crystal growth experiment on *Mir*. Protein crystals grow larger in the microgravity of orbit than they do on the ground, so the structure of space-grown crystals can be more easily measured than that of their tiny Earth-grown cousins. Better knowledge of the structure of protein crystals makes it easier for biologists to engineer new drugs. Space-based protein crystal growth represents a small but steady market for extremely high-value, low-volume space production. This is just the sort of market you want to start the first space factories. Payload Systems was so happy with the results of their experiments that the company has ordered six more three-month flights over the next four years.[28]

Originally, *Mir* was intended to last only five years; Soviet engineers outside of the space station program have pointedly complained that the modules are only now being launched when *Mir*'s core is almost that old. Cosmonauts have repaired many systems on earlier space stations, but it remains unclear just how long *Mir* can be made to last. Having wasted much of the station's potential life span in confusion, mismanagement, and occassionally solving technical problems, how can *Mir* hope to make a profit now?

Maybe a new, more advanced commercial space station is the answer. The Soviets have said that one is being planned, but some Russians have also

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implied that the project may face substantial delay; even outright cancellation seems possible unless *Mir* does make a profit, and soon. It will not have escaped arithmetically inclined *Analog* readers that all of the paying international missions together—assuming they all actually fly—will raise a grand total of some $85 million over several years. This is just over one-tenth of the stated annual operating cost of *Mir*.[6] Clearly, if *Mir* is to be enough of a commercial success to finance a new space station, most of the money will have to come from the *Crystal* factory.

As presently designed, two to three launches of the Soviets's new Saturn-V class heavy lift launch vehicle, Energia, are to place the basic space station core and modules in orbit. This will be followed by seven to eight *Buran* space shuttle launches to outfit it, according to the Minister of General Machine Building V. Kh. Doguzhiyev.[29] This requires that Energia/*Buran* be kept flying, which, given the on going collapse of the Soviet economy, seems more than problematic. Assuming the station is built, *Mir-2* was to have a truss and module structure similar to the *Freedom* design, but with individual modules weighing up to one hundred metric tons—much heavier than the *Freedom* modules. Total mass would be three hundred to six hundred tons.[30] However, the latest reports suggest that *Mir-2*, if built at all, will be scaled down to a facility only "slightly bigger" than *Mir*.[31]

The Soviet government recently guaranteed funding for two more years of *Mir* operations[32], presumably to try and recoup some of their investment. But beyond 1992, Russia's space station program remains very much in doubt.

The critical resource required for materials processing is high levels of power, likely to be a problem even on *Freedom*. The Soviets are selling one technology that could be very much in demand in the West: the already-developed Topaz reactor. Topaz converts nuclear energy to electricity with more than twice the efficiency of the American SP-100 project; the relatively primitive SP-100 reactor remains a decade or so from operation and is bogged down in financial, political, and management problems from which it is unlikely to recover. Topaz was first tested in space in 1987. It uses high efficiency thermionic technology—avoided by the United States because of its supposed "development risk"[h]—to produce ten kilowatts of usable electricity from a reactor weighing only one metric ton.[33] Want one? Topaz is marketed in the West by the American space reactor subcontractor Space Power, Inc., of San Jose, California.

Materials processing production is sometimes best done on an automated spacecraft. The advantages of reducing vibration caused by cosmonauts stumbling around is balanced against the disadvantages of not having people on board to fix problems and do research. Here, too, the Soviets have a range of

[h] As opposed to environmental risk, which should be no greater for Topaz than with any other type of space-based reactor.

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equipment unmatched in the West.

The German company Intospace, a consortium of nearly one hundred European firms interested in orbital materials processing, has been hiring spare nooks and crannies on board capsules that return film from Soviet "Resource" Earth observation spacecraft. Resource-F carried 104 protein crystal growth experiments. "The 'hold-up' in the American Space Shuttle flight queue does not suit us," said J.K. von der Lippe O. Joop, president of Intospace. "Besides," he added, "the American side provides only up to ten days to work in orbit, while the Russians give as much time as needed for research to be done" on *Mir*.[34] Intospace signed onto at least two more Resource flights in 1990, and five for 1991.[35]

The company is paying $5,000 to $8,000 per pound for the 1990 flights, which is actually quite a bit more than Western expendable launch vehicles cost (circa $4,500/lb), which shows what marketing and an already developed orbital factory can do. The first of the new flights was to carry another 104 protein crystallization experiments for European and Japanese companies. The second mission will attempt to produce synthetic crystals of zeolite, already a $400 million per year petroleum-related industry[36] that could be significantly improved through space production. Intospace's German technical contractor, Kayser-Threde, GmbH, has bought three additional Resource materials processing missions for their own use.

The Photon, a reusable spacecraft specialized for materials processing work, is another operational Soviet vehicle that Western engineers can only dream about. Western experimenters need dream no longer: Soviet managers will be pleased to sell space on one of these satellites. In 1989, a French firm, Matra, paid "hundreds of thousands of dollars"[37] for a 16-day flight of a commercial payload weighing some 20 kilograms. The Russians advertise the Photon as having "relatively low launching costs, comparatively long (up to one month) stay on the orbit . . . reusability, and big retrievable payload (up to five hundred kilograms)."[38] Photons have been launched about once a year since 1985.

A brand new class of materials processing spacecraft called Nika is under development for use later in the 1990s. Nikas will support 1,200 kilograms of materials processing equipment, supplied with two kilowatts of power for an on-orbit life of fully 120 days.[39] First flight is planned for 1993 or 1994, but the price will be an astonishing $15,000 per kilogram. Your experiment can be flown 12 to 18 months after contract signature, or sooner if Soviet processing hardware is used.[40]

A bit further in the future, Soviet engineers are considering a one hundred metric ton automated platform launched on Energia, according to Dmitriy Alekseyevich Polukhin, head of the Salyut Design Bureau. Automated "ballistic capsules" would return finished products to Earth, while Cosmonauts would visit twice a year to repair and resupply the platform. The factory is to produce one ton of processed materials every year, from twenty tons of delivered feed stock. Cost of this spacecraft is esti-

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mated at R1.2 billion, but annual production is expected to be worth fully R3 billion to R8 billion, showing an initial profit as early as 1994. Still another idea, apparently in financial and political competition with the Energia launched platform, is a twenty ton materials processing spacecraft to be launched in 1993 on an uprated Proton. This would be a free-flying version of the already developed *Crystal* module, but would also return processed materials in ballistic capsules.[41]

A more radical idea, suggested by Minister of General Machine Building Doguzhiyev, is to convert one of the three *Buran* space shuttles into an automated plant for orbital production. The shuttle would be launched sans crew and spend a month in orbit while the factory in its payload bay processed materials. Then the shuttle would land to be unloaded and prepared for its next flight.

Being the only nation with a permanent orbital infrastructure for materials processing, the Soviets have a lock on the market. But all the orbiting factories in the Universe are useless if you can't get raw materials into orbit, and then get the finished products back down to consumers on Earth. Here is a field where new Russian capitalists have to compete with their well-established Western counterparts—space transportation. The Soviets have been trying to sell the new Zenit and the ancient Proton to the West for several years.

Zenit, developed from an Energia booster, is the most modern Soviet launcher of manageable size, and as such it is the Russian vehicle Western satellite owners are most likely to buy. A consortium of Western companies hope to develop a Zenit space port at Cape York in Australia, which, being much closer to the equator than current Soviet launch pads, would substantially increase the vehicles' useful payload. The Soviets will provide components for Zenit boosters; the Cape York consortium will then assemble and launch the rockets without Soviet financial or technical participation.

The Proton is a large, Titan-class rocket with a respectable, if far from perfect, success rate proven over hundreds of launches—many more than any comparably-sized Western rocket. This venerable rocket may soon be modernized. Salyut Design Bureau head Polukhin said that by burning emergency fuel that is now left in the tanks when the rocket reaches orbit; replacing the current second stage with a modern liquid hydrogen/oxygen stage; and other improvements, he hopes to increase to Proton's payload to low Earth orbit to half again the present figure of some 20 tons. The changes would increase the geosynchronous payload to some 2.5 times that possible now. But, he complained bitterly, the Energia program is sopping up all the money available for launch vehicle development, leaving none for improving the well-proven Proton.[41]

Protons used to be launched about once a month, but government support of the production line has been reduced by 30 percent. Russian space managers are desperately trying to find Western payloads to make up the difference. The

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Soviets at first failed to get Western customers because they would not let Western technicians supervise installing the payload on the rocket. When they relented on that, the United States still would not allow any American-made components to be launched on the Proton in order to keep Western technology out of Soviet hands. Since most of the West's satellites contain American components, this is an effective ban.

The general consensus among outside observers is that the real purpose of this ban is to prevent the Soviet Union from competing with the fledgling American commercial launch vehicle industry. To a degree, such a policy is fair since the Soviet Union uses compulsory, military conscript labor to launch their rockets, while Western companies must actually pay their engineers, and with real currency. There is thus no way, within a given level of service, that a privately owned company can compete with a state-run factory. Nonetheless, this policy has serious drawbacks. By forcing satellite owners to pay more than necessary to launch their payloads, the policy makes commercial space development more difficult than it otherwise need be, which slows down the speed at which humanity can move off-planet. As pointed out in my last *Analog* article,[1] this also encourages other nations to develop their own satellite components so as not to be dependent on American policies, shifting still more of the space industry overseas.

These are not easy decisions. The choices for the United States come down to: does that nation allow the Soviets (and the Chinese and, soon, other primitive economies) to provide cut-rate launches using what is essentially slave labor? Moral issues aside, this would almost certainly kill the anemic American launch vehicle industry, but might allow the United States to preserve some of their still-commanding lead in building satellites. Or, should the Americans encourage further erosion of their lead in satellites to protect a relatively low-value launch industry? In 1989, launch services represented only $600 million out of a $3.5 billion American commercial space market.[42] Neither of these choices are particularly palatable.

One solution might be to develop a new, high-technology commercial launch vehicle that could compete through providing better service. Typically, American companies seem disinclined to try this. As General Dynamics, one of America's most competitive launch vehicle suppliers, complains, the Europeans are already far ahead with their government developed "commercial" Ariane-V, first scheduled to fly in 1995. American companies, whose current vehicles are all based on ancient ICBMs, believe they cannot afford to finance a new competing launcher on their own, while the Bush administration remains ideologically opposed to providing direct government help.[1]

In any case, the continued ban on exporting satellites to the Soviet Union serves no one's interests, save those of American companies trying to push ancient ICBMs as launch vehicles. Supporting a commercial launch industry at the expense of a healthy satellite industry is putting the cart before the horse:

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once it has been *demonstrated* that there is real money to be made in space, Western companies may yet come forth to build the railroads to orbit.

Some Russians believe they have a similar problem: spaceflight lawyer Vladimir Postyshev argued, "In the 1970s, [we Russians] could have had a monopoly [selling launch vehicles]. At present, the United States, France, China, and India have highly efficient carrier rockets and it is very difficult to compete with them."[43]

The Soviets know that, despite some early successes, they will have a difficult time securing their foothold in the commercial space market—where most of the easy money-making niches are already occupied by Western aerospace corporations with long track records. Postyshev admitted, "the Soviet Union can expect significant problems in the international space market. Why is this? Primarily, because we are entering the market very late, and the time factor is one of the most important factors in international trade."[44]

On the Russian side is the huge scale of their aerospace concerns, which dwarf their Western counterparts. The economies of scale and attraction of capital potentially possible by the immense companies of a newly "capitalist" Russia could prove an unbeatable combination. This is particularly true given the Soviets's traditional long-term vision. Still, one Russian journalist fears that the Soviets may become "merely errand boys for foreign space science. We shall carry foreign 'black boxes' for hard currency and extract unique materials not for ourselves, but for others, supplying developed (and also semi-developed) countries with unique pharmaceuticals, microelectronic equipment, [and] semi[conductors] and superconductors."[41]

But if the Soviets do pull off their plans for commercial factories in orbit, supported by a commercialized launch industry, will American companies be able to compete?

The short answer is "no"—for the same reason the United States is experiencing little success in competing against the Europeans with launch vehicles. Every other nation attempting to commercialize space is helping its industry; only the United States insists on an ideologically pure "capitalism." This policy is doomed to failure since no company or corporate league can raise sufficient capital up front to open the Solar System.

Terrestrial frontiers requiring significant investment in infrastructure (e.g., ships or bases) have been colonized most successfully with a type of organization called a "government chartered company." Examples include the British East India Company; the Hudson's Bay corporation created by

[i] Note the dismal history of the entrepreneurial small launch vehicle industry in America. The mythology of would-be space entrepreneurs aside, the problems of this industry can be blamed more on a lack of commercial customers than on government over-regulation. The one small launcher that looks like it might be successful, Orbital Science's Pegasus, was only developed with large market guarantees from the Pentagon—over the Bush Administration's active opposition. The head of the Defense Advanced Research Project Agency was "transferred" shortly after Pegasus' first flight for providing help to a number entrepreneurial companies, including Orbital Sciences.

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Britain for the colonization of Canada; or in space, the American initiated Comsat/Intelsat Corporations, and Europe's Arianespace and Spot Image Corporations. These kinds of government-financed companies, combining relatively efficient corporate management with a government's vast access to capital, are a tried and true method of opening new frontiers, although they rarely, if ever, make money. That is left to secondary companies following in the wake of the government-financed pioneer. Europe's Arianespace, for instance, has taken over much of the commercial launch industry once dominated by United States government agencies like NASA and the Air Force, while Spot Image is in the process of doing the same thing to the Landsat industry, which likewise was first developed in the United States.

No one seriously believes Europe is making a net profit with the Ariane program. What they *are* doing is positioning themselves to make huge profits by dominating the launch vehicle market of the future when large amounts of material is regularly delivered to orbit. American companies, having to show real profits right now and without Arianespace's near-infinite access to capital, are finding it almost impossible to compete. Soviet chartered companies like the Energia Group, which manufactures the Zenit and Energia launch vehicle and some Soviet space station components, should have many of the same advantages.

The only American commercial spaceflight success to date—the communications satellite industry—was created by just such a government chartered company, Intelsat/Comsat, and a huge government investment in the early years. Intelsat/Comsat—and various secondary and supporting companies, many of whom would not exist without those government-financed pioneers—now generate billions of dollars in revenue for the United States, both through provision of communications services and because that nation still builds most of the satellites. A large up front government investment created a whole new industry that is now one of America's principal exports.[46]

On the other hand, the Reagan administration's attempt to commercialize another pioneering space technology with insufficient government support—Landsat—has been a financial and technical disaster, costing the United States any real chance of competing in the rapidly growing commercial Earth observation market.

Ideological opposition to "industrial policy" by the Carter, Reagan, and Bush administrations is the primary reason the United States has not been able to duplicate the Comsat feat, squandering what was once three decades' lead in space technology.[j] If the United States is to open the Solar System, Americans will somehow have to combine their unparalleled entrepreneurial inventiveness with some kind of government-supported process for moving those inventions from the laboratory to reality. If the United States can do that without destroying that inventiveness,

[j] The 30-year-old Atlas Centaur launcher is still just barely able to compete with the world's most modern expendable launch vehicle, the European Ariane-IV.

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they will have created an unbeatable team.[k] But in the meantime, the other nations of the world simply consider space industrialization too important to leave to America's current idea of pure capitalism.[l]

Will the Soviet Union's "commercialized" aerospace industries, the world's newest and most dynamic space entrepreneurs, fare any better? Can they bail Russia out of seventy years of socialism?

Even with the vision and technical advantages described above, most probably not: after funding most of the initial investment for other purposes, after coming *so* close to pulling it off, the Soviet Union now cannot afford the rest. Most of Russia's advantages in commercial space are tied up in human spaceflight. Yet their human space industry already has been cut 28%,[45] and rumor has it that human spaceflight will shortly be cut to the bone by the Soviet Union's new legislature. If so, Soviet commercial space prospects boil down to a race between three forces: massive government cuts, the on going collapse of the Soviet Empire, and finding foreign sources of investment.

While the Russians have been more successful than I think anyone suspected was possible at earning commercial income from human spaceflight, time is not on their side. Having won the political war, the West could afford to help. Since the Soviet Union remains the world's most accomplished spacefaring power, the success of Russian commercial space could well determine whether humankind's future is a spacefaring one.

I would like to thank congressional staffer Tim Kyger, and science fiction authors Loren J. MacGregor and Kevin O'Donnell, Jr., for their help in preparing this article. Of course, all opinions and any errors are my own.

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[k] Commercial space is often compared to the computer industry, but the investment needed to open space to industrialization is orders of magnitude higher, as is the length of time before investors can expect a return on their investment. And much of the early research and development in computers was paid for by the government. The railroads are a better example, but contrary to popular mythology, they operated under huge government subsidies. More importantly, they had San Francisco sitting out there on the West Coast—an already-existing market to reach. The space industry's San Francisco has yet to be built, and commercial space is unlikely to take off until it is. This suggests to me that a Lunar Base should be commercial space advocates' highest priority.

[l] Look to Europe for commercial space in the near term. No one gets more spaceflight for less money than the Europeans. The reason? Nonideological decision-making. The Europeans adapt proven methods for making money on a new frontier—without preconceived notions of what capitalism should or should not be.

(1) Donald F. Robertson, "Mars: the Soviet March," *Analog*, March 1989, pages 33-49.
(2) Randall Rothenberg, "Soviets Planning to Launch Ads into Space," *New York Times*, 13 July 1989, pages A1, C17.
(3) B. Konovalov, "Cosmonautics at the Crossroads," *Izvestia*, 18 May 1989, Morning Edition, page 4.
(4) Colonel M. Rebrov, "Aeronautics, the Year 2005," *Krasnaya Zvezda*, 25 August 1989, page 4.
(5) "Working Report from the Crew," *Pravda*, 25 May 1989, First Edition, page 2.
(6) "Soviet Says *Mir* Cost $2.4 Billion Since

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1986: dearth of shuttle flights linked to money—not technical problems," *Space Station News*, 5 June 1989, page 6.

(7) Moscow World Service, 03:10 GMT, 7 September 1989.

(8) Yuriy Korotkov reporting, Moscow Domestic Service, 15:00 GMT, 23 May 1989.

(9) TASS International Service, 16:00 GMT, 31 May 1990.

(10) Moscow Domestic Service, 15:00 GMT, 31 May 1990.

(11) V. Umnov, "The Secret at Fili," *Komsomolskaya Pravda*, 14 September 1989, page 1. *Analog* editor Stanley Schmidt expressed some doubt regarding the figures, as did Kevin O'Donnell, Jr. I agree that they seem unlikely, but are directly quoted from the Foreign Broadcast Information Service translation of this source, and I will let them stand as a reflection of apparent Soviet thought.

(12) Moscow World Service, 11:10 GMT, 21 August 1989. Presumably, these figures are in Rubles.

(13) Andrey Filippov reporting, TASS, 22:06 GMT, 11 March 1990; TASS, 18:31 GMT, 15 March 1990; and Rena Kuznetsova reporting, TASS, 09:45 GMT, 23 March 1990.

(14) Rena Kuznetsova reporting, TASS, 08:03 GMT, 8 May 1990.

(15) "*Medlab* to Dock with *Mir* in 1995," *Soviet Aerospace*, 20 February 1989, page 8. *Soviet Aerospace* is an American publication.

(16) V. Kobelev and A. Bachmanov, "You Wanted to Know: economic return from space orbits," *Selskaya Zhizn*, 18 May 1989, page 3.

(17) Joan Wisner-Carlson, "Financial Backers Withdraw from UK-USSR 'Juno' Mission," *Space News*, 2-8 April 1990, page 5.

(18) Gerald Nadler, "Japanese Journalist Chosen for Space Flight," United Press International, 13 November 1990.

(19) B. Konovalov, "Cosmonautics at the Crossroads," *Izvestia*, 18 May 1989, Morning Edition, page 4.

(20) TASS, 20:00 GMT, 28 February 1990.

(21) David Swinbanks, "A *Mir* $10 Million," *Nature*, 22-28 December 1989, page 842.

(22) Theo Pirard, "*Mir* for Sale," *Space Calendar*, 27 August to 2 September 1990, page 2.

(23) "Austrians Selected for Soviet Space Mission," *Soviet Aerospace*, 16 October 1989, page 8.

(24) S. Leskov, "A Road Into Space Ten years Long," *Izvestiya*, 23 December 1989, page 12.

(25) Jeffrey M. Lenorovitz, "Soviets Book New Commercial Spaceflights: long-term cooperation with France advances," *Aviation Week and Space Technology*, 10 July 1989, page 25.

(26) Peter B. deSelding, "Cost of Next French Mission to *Mir* Climbs to $25 Million," *Space News*, 6-12 August 1990, page 44.

(27) "China is Next *Mir*-Bound Country, *Space News*, 1-7 October 1990, page 2.

(28) Andrey Sitov reporting, TASS, 10:18 GMT, 7 December 1989.

(29) V. Kh. Doguzhiyev, "Examined in the Presidium of the USSR Council of Ministers: space outlays and returns," *Pravitelstvennyy Vestnik*, May 1989, pages 2-3.

(30) "New Soviet Space Station to Resemble U.S. Facility," *Soviet Aerospace and Technology*, 18 June 1990, pages 7-8. This is the new title for *Soviet Aerospace*, an American publication.

(31) Radio Moscow to Great Britain and Ireland, 19:00 GMT, 19 May 1990.

(32) Lon Rains, "Soviets Cut Space Again," *Space News*, 20-26 August 1990, pages 1, 20.

(33) William J. Broad, "Russians Disclose Satellites Carry New Reactor Type," *New York Times*, 15 January 1989, pages A1, A10.

(34) TASS, 23 September 1989. The Russian phraseology of this sentence suggests to me that it is a paraphrase, rather than the direct quote TASS made it out to be.

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(36) Peter B. deSelding, "Germans Sign Deal for Discount Use of Soviet Soyuz Rockets in '90," *Space News*, February 26 to March 4, page 3.

(37) Moscow Television Service, 17:00 GMT, 27 April 1989.

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(39) TASS, 16 May 1989.

(40) Phillip S. Clark, "Vostok Variants for Commercial Users," *Interavia Space Markets*, November / December 1989, pages 308-309.

(41) Andrey Tarasov, "Cosmonautics of the Future: choice of paths and orbits—the orbital factory," *Pravda*, 17 May 1990 second edition, page 3.

(42) "Commercial Space Takes Root," *Aviation Week and Space Technology*, 23 April 1990, page 9.

(43) Vladimir Postyshev, "Time to Rethink Soviet Space Policy," SPACE NEWS, 14-20 May 1990, pages 15-16. Reprinted from the Novosti Press Agency.

(44) V.M. Postyshev, Candidate of Juridical Sciences, Institute of Government and Law of the USSR Academy of Sciences. In *Zemlya i Vselennaya*, July-August 1989, pages 21-27.

(45) Lon Rains, "New Soviet Austerity Seen as Threat to Shuttle, *Mir* Programs," *Space News*, 9-15 April 1990, page 8.

(46) It should be clear from this that I agree with much of what Stephen L. Gillett said in *Analog*, February 1989, pp. 52-65.

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Probability Zero

SPLIT END

Mark S. Miller

Director Harold Oliva stared out the window, collecting his thoughts. A steady drizzle was slowly soaking the people twenty-three stories below him on the streets of San Diego. God, he hated Mondays. And this Monday was particularly bad, with the budget review only two weeks away. That would be his highest priority, of course, although he still hadn't found the replacement administrative chief. . . .

An annoying buzz from the phone snapped him from his reverie. He took a deep breath and hit the button. "Yes, Cathy?"

"It's Doctor Culver, sir," came the tinny voice. "He—wait, I haven't—"

The door swung open and the technical chief walked unsteadily into Harold's office, clutching a nearly empty bottle of Cuervo Especial. The thin man stopped to lean on one of the chairs and, after a moment of concentration, finally flopped into it.

Harold faced him evenly. "All right, Jim. I didn't even know you drank, and

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here you are breaking into my office, drunk, first thing in the morning. This better be good."

" 'S good, don' worry 'bout that." The technical chief burped slightly and continued. " 'Sides, s'not first thing in the morning. Worked all night. Got it all figgered out aroun' . . ." he stopped to stare at his watch. "'Bout two hours ago."

The director leaned back in his chair. "Got what figured out?"

"Th' *big question*. Y'know, what happens if we, um, if we actually change somethin' in the past 'stead of just lookin'."

He sat forward again. "You did it? You found the answer?"

"Yep."

"Well?"

" 'S very tricky thing, really. A guy broke orders and made a change. May've been an acciden'. Not certa, um, certh," Jim stopped and closed his eyes for a few seconds. "Not *certain*. Yeah. Not certain if it was 'quipment failure. Anyway, th'guy manifested 'bout two hundred years back. Showed up on alla insterments, of course. Rippled all up an'down time, showed up on all kindsa tracks. Lotsa good data, real clean."

The director licked his lips, suddenly uncomfortable. "So obviously it's possible to change the past. What does that do to the present?"

" 'S not so simple. Time splits. Just like d'Koenig's theory. Two parallel universes, one unchanged, th'other's got the change in it. But." He stopped and aimed a shaky finger at Harold. "But. But. But the changed timeline is only a virtuous . . . no, virgil . . ." He shook his head. "Virtual. Ah. The changed timeline is only a *virtual* line. 'S got all the people, complete with memories, even got its own time travel project, but it only lasts for a little while. How long depends on the change, 'bout fifteen hours this time. Then, poof, it's

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all gone. All th'virtual people gone. All dead, only more so." He glanced down at the bottle. "Course, it's prob'ly a painless way t'go."

Harold stared at him, appalled. "De Koenig was right? Damn, and we accidently did it. Shit, if the council finds out about this, they'll shut down the whole project. How long until the virtual timeline disappears?"

"Tough to say, tough to say. Maybe 'nother hour, maybe less, who knows?" He giggled to himself. "At least it hasn't happened yet."

"Is there anything we can do? Try to send someone to stop the guy who made the change? Anything?"

The technical chief shook his head back and forth. "Nope, nope, nope. 'Nother person'd only make another split, more virtual people. Even worse."

The director rubbed his eyes. "God, I don't need this. What period did this moron change?"

"We tracked 'im down," he replied somberly. "Very accurate. Early Victorian era, somewhere'n Asia."

Harold blinked. "Victorian era? Asia? We weren't operating anyone there."

"Nope. 'Guy wasn't sent by our timeline."

"But how could the other timeline send someone? The virtual timeline wouldn't exist until the change was made, so if the virtuals made the change, they'd be creating themselves. That's logically impossible."

"Yep, tha's impossible." Jim raised the Cuervo to his mouth and finished the last few ounces. He looked at the bottle gravely and then dropped it on the floor. "Tha's why I got the tequila. Figgered I'm not gonna hafta worry 'bout the hangover."

The director's eyes grew wide. "What? You mean *we're* the vir ■

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THE SHRIEKING OF THE NIGHTINGALE

Robert R. Chase

"Do not do unto others," wrote George Bernard Shaw, "as you would have them do unto you." Because . . .

Grace waited for them in her library. The walls were hung with shaman masks, with maps of the mines of Tartessus, with aerial photographs of the Avebury circle. Shelves, stretching floor to ceiling, were filled with the books which were her oldest friends. Among them were not a few that she had written.

Outside the window, which had been opened to admit an early summer breeze, a nightingale perched on a branch, seemingly near enough to touch. It strutted back and forth, its head cocked, beak shaking as if with a prodigious yawn.

The door was unlocked. She had thought of throwing the dead bolts, of piling the furniture behind the doors, making them realize by their breaking and entering what manner of barbarians they were. She had even done so. Then her Scots soul, frugal and practical, had reasserted itself. There was no need for locks to be broken, for door frames to be smashed (locks and door frames which *she* would have to repair) for no more than a futile gesture.

Until a week before, she had been so confident she would win! Even though she was old enough to be slightly embarrassed at the supporting brief filed by the Gay Alliance, not to mention its lurid rhetoric ("This is just the begin-

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ning of a legally sanctioned cultural genocide . . .''), the dollars they had spent on lawyers and advertising had been mightily welcome. And despite her attorney's careful explanation of the police powers of the state, of the motorcycle helmet laws and the Jehovah's Witnesses transfusion cases, she clung to the belief that when they finally realized how determined she was, and that she *could* take care of herself, they would have to leave her alone.

She felt their approach through her heels. She turned, expecting, *hoping*, to see angry faces, clenched fists holding weapons. The first pair of eyes she met belonged to a sheriff's deputy. The boy looked young enough to be her grandson. He flinched away from what he saw in her face.

Mrs. Landers, the deputy said, bobbing his head nervously, *I have here a warrant for your remedial medical detention. If you will please come along with me—*

I will come because you will take me, she interrupted. *You are in my house without permission. You intend to violate my body in a manner which amounts to a continuous rape—*

That really upset the deputy. For a moment she allowed herself to be distracted, regretting that this basically decent boy had to be her enemy.

—and I have no intention of cooperating with you. Do what you will.

The paramedic opened his mouth to speak. Grace dropped to the floor, wrapped her arms around her knees and closed her eyes, shutting out their babble.

For a few breaths, nothing happened. Then hands reached tentatively under shoulders and knees, locked together, and lifted.

The paramedic tried talking to her in the ambulance. Grace turned her head away until he gave up.

As the ambulance landed at the hospital, she curled back into fetal position and let them carry her out. The air was cool and damp. After four steps, she was unexpectedly jostled. Her eyes opened in surprise. A middle-aged man, veins standing out from his neck, was trying to push the deputy away from her. Behind him, other protesters shook placards.

The deputy's face hardened. He caught the man's hand, separated the fingers, and moved him off with surprising ease.

She kept her eyes closed the rest of the trip. Into an air-conditioned space for six paces, then a sideways shuffle into what turned out to be an elevator. She was slung out of that, carried ten paces, held still for a moment. Three more paces, and she was deposited (gently) on a rug. By the time she opened her eyes, the door was already closing.

It had been years since her last stay in a hospital, and things had changed. Besides the rug, there were drapes on the window, blowing with a freshening breeze. An entertainment center, complete with holoscreen, covered most of the interior wall.

Only the bed would have looked out of place in an ordinary apartment. Machinery just visible beneath the bedspread would allow the bed to be raised or lowered to any desired configuration.

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When she sat on the bed, the panel above the headboard came alive with her name and social security number. Beneath that, in fluctuating red digits, her temperature, pulse rate, and blood pressure. And beneath that, in an incomprehensible medical shorthand, what had to be her relevant medical history.

No effort of hers could raise the window more than three inches. The door had no handle.

She sat on a chair in the middle of the room, trying to compose herself. It was impossible, of course, that she should win a contest of force with the state. Yet the restraint with which she had been apprehended and the relative luxury of her present surroundings suggested, if not a concern for welfare, at least a feeling of guilt. Perhaps she could use that.

It was all she had.

Two hours later, at noon precisely, lunch was brought in by a nurse. Guards stationed outside the door discouraged any thought of escape. For a minute she contemplated the tray, wondering if she should stage a hunger strike. She decided not to for two reasons. Hunger strikes, even for causes with which she agreed, had always seemed gratuitously self-indulgent: the adult's version of Give-me-my-way-or-I'll-hold-my-breath-till-I-turn-blue.

The second reason was that the food smelled delicious. This was an even more radical change than the room furnishings from her last hospital visit. Thinking it over, she could find no reason to weaken herself in whatever confrontation might lie ahead.

The nurse returned for the tray an hour later. With her came a visitor, a woman perhaps ten years younger than Grace dressed in a severe but handsome business suit.

Good afternoon, Dr. Landers, she said. *My name is Ellen Masters. I am with the Health and Human Services Rehabilitation Adjustment Unit. I tried to see you before the trial, but your attorney stated that government visitors were not welcome. I think . . .*

For just an instant, a break appeared in her professional facade. *I think if I could have seen you earlier, you would have been spared the trauma of this morning's arrest. Now that you are here, I want to make your stay as pleasant as possible.*

It can be made most pleasant by making it end, Grace replied. *Take your goons away from the door and let me go home.*

If you'll just let me explain—Masters began.

Explain why a citizen who has paid her taxes every year, raised a good family, taught a generation of students, and never received anything more serious than a parking citation should be dragged from her home and imprisoned in a hospital?

You are deaf! Masters blurted.

Yes, Grace said, proud of her self-control despite the rage which rippled through her. She concentrated on the shape of her lips, the position of her tongue. It would be too easy to let strong emotion render her unintelligible. *Until recently, that was not against the law.*

Until recently, nothing could be done about it, Masters replied. *But now we can. We can make people whole in ways*

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that prophets could only dream about. The blind see, the crippled walk, the deaf hear. Maybe you are afraid of the disappointment if the operation fails but, I assure you, it never fails. At worst, more than one treatment may be needed. While you are unconscious, the neural regeneratives will be applied to your aural nerves and those portions of your brain which are used to process sound. There is absolutely no pain.

I have helped scores of unfortunates readjust to full, complete lives. There is no more rewarding work in the world.

How rewarding for you, Grace said, bleakly. *Why must I be an object of your compassion?*

For safety reasons alone, Masters replied. *You need to hear the emergency warnings in your flitter, the danger signals near a levi-train station.*

I can do very well without flying myself, and I am quite alert enough to make do with visual warnings if they are provided.

Masters shook her head. *Any number of studies have proven that aural warnings are up to ten times more effective in emergency situations, if only because you do not have to be looking in any particular direction to receive them. In the quick-moving environment of today's cities, it is simply necessary to be able to hear.*

And beyond that, any intellectual like yourself must want to stay in contact with the rest of the world. If you have no access to holovid—

I can still read, Grace interrupted, *whether real books and magazines or a computer screen. And there used to be closed captions on holovid.*

Masters shook her head slowly. *When there was audience for them. But don't you want a share in the beauty that has been closed away from you all your life? There is so much wonder, so much joy in a bird's song, in music—*

I do not wish to hear the slither of violin strings, or the shrieking of the nightingale. I miss these things no more than you miss being able to hear the songs of bats, or being able to see the Sun's neutrino flux shining through the Earth. I wish only to be as I am and always have been.

What about your children? Masters asked.

Grace bit her lip, astounded that this naive, sincere woman could hurt her so cruelly. *I taught Thomas his first signs when he was one year old. His father had become deaf in his late teens from otosclerosis, but my son inherited my genetic—* She bit back the word "defect"*—makeup. People were only beginning to show the long-term effects of throwing billions of tons of chemicals into the air and drinking water.*

Thomas was a smart boy. He met Jenny at Gallaudet. Their first child would naturally have been born deaf. But . . .

But that was the year Jenning-Davis became law, Masters said, after waiting for Grace to continue.

The Anti-Maiming Law, they called it, Grace said bitterly. *Genetic screening was made freely available. Likewise genetic repair. The catch was that if you failed to make use of the services, and your child was born with one of the listed defects, you would be held criminally liable as if you had purposely assaulted the child.*

In the first three years, we wiped out

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cystic fibrosis, Masters said. *And mongolism and cleft palates, and sickle-cell anemia, and a hundred more disorders, the accumulated detritus of thousands of years which had crippled and killed our children.*

They thought of leaving the country, Grace continued, *but most of the other nations were enacting similar laws. Even most of their deaf friends, whose children were naturally born hearing, failed to realize that this was just the first step.*

By the time he was three, there were problems with Mathew. The county had mandated special vocalization classes, to make sure that he made progress in his speaking skills. He didn't want to learn to sign. Day by day, they felt him growing farther away from them.

They are very happy now, Masters said. *I visited them a month ago. I was hoping they could help me persuade you. They told me that relations were . . . strained. They said there was no way they could talk to you.*

They were right! Grace said. *They have forgotten how to talk. Their hands are slow and awkward. The last time they visited me, they weren't thinking in sign at all. They were thinking in heard words and translating.*

But you lip-read so well . . . Masters began.

Grace shook her head. *You persist on missing the point. We were a people. We had our own way of thinking, our own way of communicating, that was just as good as your own. It was our culture. First you prevented us from handing it on to our children. That was not enough for you. So much you hated our way that you could not even wait for old ones like myself to die.*

Masters's face worked, but for a minute she said nothing. She reached out her hand, as if to comfort, but drew it back quickly as Grace flinched away from her.

None of us hate you, Dr. Landers, she said at last. *I volunteered for this assignment because I was one of your students, years ago, in the introductory course you taught. I thought you were a great woman then. I know you are now. Once this is over, you will have years of even more productive life ahead of you.*

If you want to talk to me any time before the operation, just actuate your phone and speak my name. The system will connect with me anywhere in the building.

Grace bit her lip until the door closed behind Masters. Which old pope had coined the phrase, "invincible ignorance?" Masters was so wrapped up in her own idealism that she had heard nothing Grace had said.

Ironic to think that, in her own way, Masters was more deaf than she was.

Grace paced the room, sipping the tea which had been provided with her lunch. They would probably come for her by midafternoon. That would be her last chance. She had allies. The demonstrators outside the hospital proved that. Were any of them inside? If not, what about holocam reporters? How would the hospital staff react to having the whole world see them wrestle an old woman down the corridor to an operating room?

For that matter, how would the doctors and nurses themselves feel about

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having to do that? Most of them undoubtedly had as little imagination as Masters. They would think her a silly old woman with irrational qualms whom they were helping despite herself. Perhaps they would have qualms of their own when they realized the strength of her determination.

Despite the hormone supplements she had been taking recently, her bones were still brittle. She had never thought that fact would make her happy.

She sat down in the chair to savor the scene she imagined. A feeling of contentment stole over her. Only as her eyes closed, and the cup slid from her hand, did she realize that her adversaries had anticipated this, too.

She woke, completely rested, but with an immediate sense of strangeness. Memory flooded back through her along with the wash of alien sensation.

This was hearing. As strange and horrible as it was, she immediately distinguished two separate sounds. The first she correlated with the heaving of her chest, and knew to be sobbing. The second was a spidery scratching overlaying something like the approach of heavy, menacing footsteps. It was some time before she learned that this was the beginning of the Pachelbel Canon in D major. ■

●Never discourage anyone, Theaetetus, who continually makes progress, no matter how slow.

Plato

●Take care not to do anything that could provoke the envy of others.

Pythagoras

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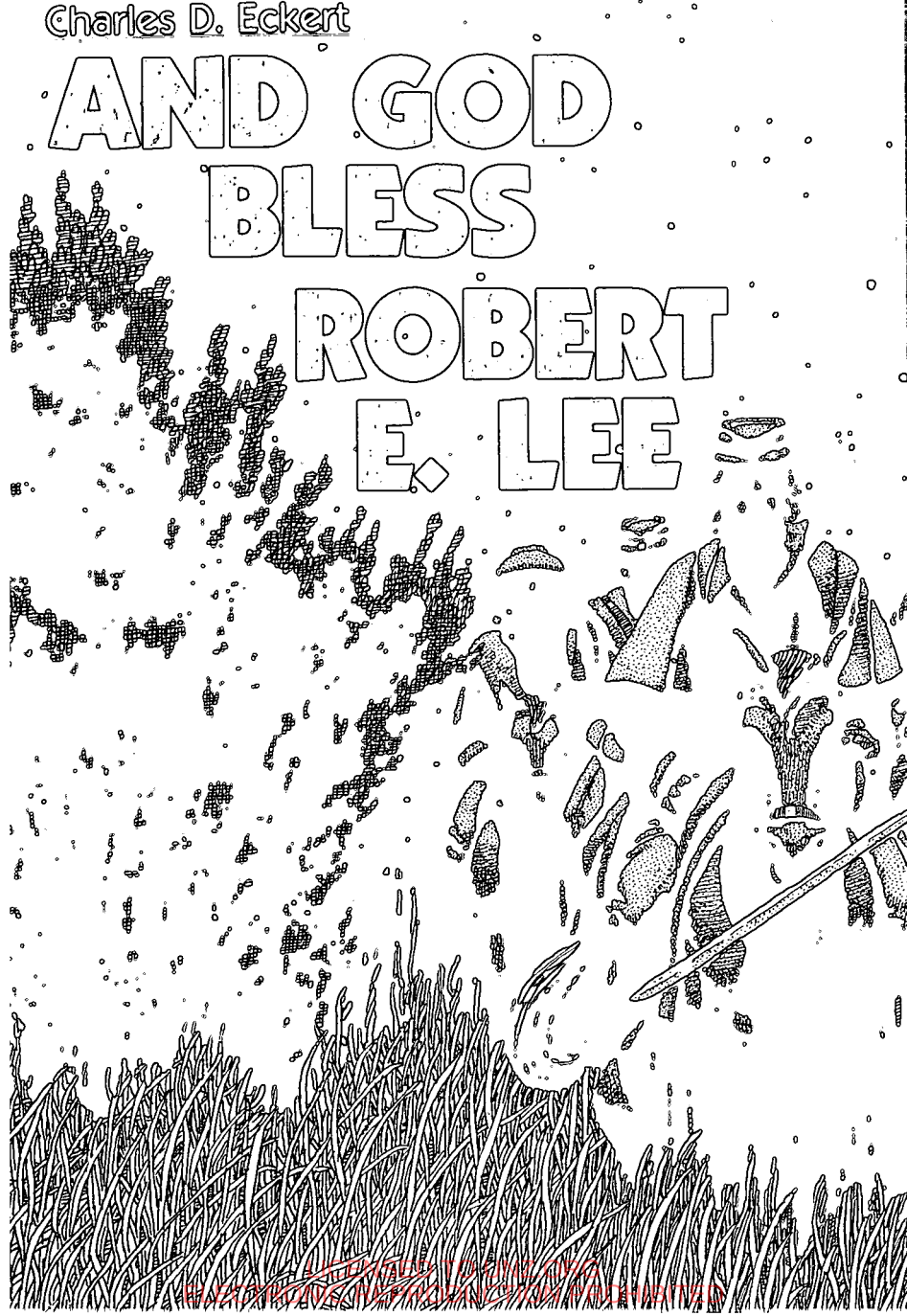
Charles D. Eckert

AND GOD BLESS ROBERT E. LEE



LICENSED TO MELONS
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". . . Their tongues loosed as by electric touch, and there comes forth a voluntary fury of sound: a rumbling, consuming, discordant, demoniacal, stupendous volume of unheard of, unpunctured, indescribable, awe-inspiring noise, that increases in volume each flying moment, sways back and forth, as a mighty chaos of leaping, flying, rolling thunder. The earth seems to tremble beneath the feet of these infuriated sons of men. It was the awful 'rebel yell,' which fixed itself in the minds and hearts of all who ever heard it."

—A Drummer Boy of Shiloh
(Vic Reinhardt, 1910)

"In the name of The Objective," said G'bett, "what is *that?*"

The alloy corridors of the ship echoed with sound. Volume increased each moment, swaying back and forth, like a mighty chaos of leaping, flying, rolling thunder. Awe-inspiring noise reverberated off the composite bulkheads.

R'old smiled and said: "The last 'Rebel Yell.' "

"Indeed?"

"To be sure," the taller candidate went on. "J'apt obtained the recording in 1949, by surreptitiously monitoring an interview with one of the then pitifully few survivors of the Army of The Confederacy. The old man was 107, at the time, and died shortly thereafter. The fellow's eldest son claimed it was the yell which finally took him."

"Quaint."

"The scout ship's drive buggered the original interviewer's archaic tape machine, naturally. So, you have just listened to the only recording extant. Good quality, don't you think?"

G'bett nodded, smoothing the ruffled hair on the back of his neck.

"J'apt is rather proud of it," said R'old.

"She would be."

"Don't be bitter, G'bett. Just because her dissertation is in better shape than yours is no reason to begrudge her accomplishment. After all, no living human has ever heard that sound."

"I know," G'bett said, "but—"

J'apt appeared in the hatchway.

She threw back her head, repeating the sound the boys had just heard. This time it had a curious feminine lilt to it. Yet the new rendition was accurate and unsettling, nonetheless. She laughed good-naturedly at the end of it.

"Gentlemen," said J'apt, "are we ready to put on a show for the primitives?"

Richard F. Bannon finished his prayer.

Even after fifteen years he was as moved as he had been on the day Grace died. The weather had been clear and warm, as it was now, he recalled. Grace had always liked this little cemetery. It was a comfort for him to regularly visit the grave site: her resting place after thirty-two years of marriage and a lifetime of rural enterprise. Eventually, he would be beside her. It was only right. Bannon put the flowers he invariably brought with him into the cast vase at the base of his wife's headstone, wiped his eyes, stood up—and found himself staring into the business end of the most wicked looking weapon he had ever seen.

* * *

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"No, no," B'ult was saying, "The Morgan command, in various detachments, reached Brandenburg on the Ohio early on the morning of July 8, 1863. They didn't cross the river into Indiana, at Mauckport, until the main force arrived on the ninth. One of our previous expeditions recorded the entire raid, as it happened. You *could* check the cubes."

"Pardon me for breathing," D'olt said. "By the way, what's this I'm drinking?"

"Mint Julep," said G'bett.

"Not bad."

"Some traditions just won't die," said T'obb, the new first year.

"Why should they?" J'apt said to him. "Observations can be boring enough, if that's all you do. Why shouldn't we have a bit of fun into the bargain?"

"This time," said D'olt, "we should contact Central Office."

"I can just hear that," said B'ult: "Venerable Bureaucrat—I respectfully request permission for 'a non-contaminating close encounter.' After all, Honored Academician, the observers won't be *believed!* And you've said my thesis isn't original enough, but all the routine observation stuff has been mined out—"

"That sounds like what's his name, Pournelle?" said J'apt.

"The point is," G'bett said, "those stuffed suits at Central would never buy it."

"So," said T'obb, "we don't tell them?"

"You're brighter than the average first year," said B'ult.

"Pay no attention to him, T'obb," J'apt said. "He was a lowly first himself, once."

"When?" B'ult said.

"Seven home years of graduate work wasted, eh?" said D'olt.

"This means," said G'bett, "you shouldn't worry about it."

"True," said J'apt. "It's all been going on for a very long time. How is Central to know? Hm? *We're* not saying a thing, not a word. Theoretically, the risks are too great. The more intelligent of the natives don't really believe in us, anyway, even if some first year—no offense—screws up and one of our survey ships is spotted. I mean, think about it for just a moment: in their place, would *you* believe in 'flying saucers'?"

"Besides," said B'ult, "who are the autochthones going to tell? One of their supermarket tabloids?"

"The only way Central Office could find out," said J'apt, "is either by a surprise visit from the Examiner's Board—which hasn't happened since Proxima Gamma went nova, and stink is *still* drifting about *that!*—or by Central actually contacting the natives."

"And if they did that," G'bett said, "this planet would no longer be a prespaceflight culture. Would it?"

"The Objective would be lost," said T'obb.

"Precisely."

"If all else fails," said D'olt, "I suppose one might take the route of Earth politicians: 'plausible deniability.' "

" 'Why, Captain Butler,' " J'apt said, in her best accent, " 'whatever do you mean?' "

Well, I'll be, Bannon thought, cautiously raising his hands above his head.

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If the sun is at your back and the angle of the muzzle is just *right, you can actually look down the barrel and see the shell in the chamber.*

He would never have believed it.

Then again, Bannon had never been this close. He scanned the matte black lethality of the metal.

"Who are you?" a deep voice rumbled.

The face behind the imposing firearm seemed quite frightened, questioning: a young man in his early thirties, eyes hard and shading to a gray desperation, had Bannon nailed. His clothes appeared slept in and soiled by ash and wood smoke. That is, if smell meant anything.

There was movement to the right.

"Jon, don't," a feminine voice said. "He's just an old man."

Not so decrepit, Bannon thought. *I can appreciate a beautiful woman.*

Even one who toted a 12-gauge shotgun like she knew what she was doing with it. Disturbing. Bannon handled this new development as he had the first: with blocked bowels.

The young man relaxed noticably when the woman approached, but his weapon remained aimed at Bannon's chest.

"Who are you?"

"The name's Bannon," he said, reclaiming his voice, "Richard F. I live about—easy with that thing, son!—five miles west of here. Have all my life. I come around occasionally to place flowers on my wife's grave, and talk with her a while, as an old man will. Can't say I've ever seen you two before."

Seconds coagulated.

"It's a pleasure to meet you, Mr. Bannon," the woman said. She lowered her weapon and offered her hand. "My name is Erin Somners. 'Mad Mike' Hoare over here is my husband, Jon. He's actually a nice person when he's fed. We bought the Lathropt place."

Bannon gingerly dropped his hands. He accepted the salutation from the pretty redhead. Yet his eyes tracked back to the dark-haired man.

"Make a habit of drawing down on your neighbors, young fella'?"

Jon Somners looked genuinely embarrassed.

"My apologies, sir," he said. The weapon's butt came to rest on his hip, the muzzle pointing skyward.

"Somners, you say?" Bannon said, shaking the young man's hand. "I've heard the name in town. So, you're the folks who purchased the old homestead? Got your work cut out for you. But I can see, by just looking over the hedgerow at the farm, that you've already done a fine lick of toil."

"You're too kind," said Erin.

"You're right about one thing, Mr. Bannon," Jon said. "We don't usually greet our neighbors at gun point. It's all rather complicated."

"We're not sure we can explain it to ourselves," Erin added, "much less to—"

"Some old geezer," said Bannon, "who looks as though he's been a farmer all his life, and might have trouble believing in telephones, television, tight jeans, or microchips, not to mention what you've got to say. Is that it?"

She blushes just like Grace used to, Bannon thought.

"You cut through things directly,"

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Erin said.

"I try," said Bannon. "It may sound old-fashioned, but life is too short. My wife, here, taught me that. Besides, if you spend enough time around barnyard manure, you get so you know when you see, smell, or hear it."

They laughed.

Yet something remained unsaid.

"Let me try it once more," Bannon went on. "You both look like you've been rode in hard and put away wet. You've recently bought and fixed up this property. Now, you're roaming a country graveyard in the dawn's early light, armed for insurrection, and looking for . . . what?"

The young people gaped at Bannon, then at each other, as the old fellow asked: "Does the name Morgan mean anything to you?"

Erin Somners collapsed.

"If y'all don't come to order this time," bellowed K'lee, "to blazes with it!"

He was getting into character and gray, gold braided uniform, along with everyone else. It was expected. Part of the fun. Grumbling settled to a dull hum, then to moderately respectful quiet.

"The chair recognizes our beloved engineer, G'ort."

Lanky as an I-beam, the engineer unfolded himself from his seat. "I thank the chairman," G'ort then belched, low and loud.

"Can't take you anywhere," said M'lit, as she looked affectionately at her consort. "Say you're sorry."

"Sorry." G'ort gathered his faculties, then said: "I am pleased to report that the new—professional, exterior *theatrical quality*, I may add—*H*olographic *O*mnivisional *P*rojection *E*quipment has arrived."

Sounds of general approval.

"We have our brave, influential, and decidedly corruptible chairman to thank for that," said J'apt.

"It *was* a dirty job," K'lee said, "but somebody likes to do it."

"To be sure," G'ort said. "The installation has just been completed. And I must say I am proud of the new baby. HOPE is flexible in the extreme and performs above specs, i.e., she's capable of almost anything. This year's festivities will, therefore, be enhanced a full order of magnitude over past extravaganzas."

"Does the gentleman yield?" said J'apt.

"The chair recognizes anthropologist J'apt."

"I thank the chairman," she said. "There will be an additional bonus for the chapter, tonight. It seems our playground has some new residents."

"Indeed?" said R'old. "That *will* be fun."

"True. But remember: there should be no deviation from historical accuracy and tradition. Everything goes according to plan, as always. *We* are the primary audience—for the record—and anyone else is 'just gravy.' "

To this, there was universal agreement.

"Is there any old business before this body?" said the chairman.

"NO!"

"OK," K'lee said, fully absorbed in his character. "Let's get 'er done, Rebs!"

* * *

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"Feel better, Mrs. Somners?"

Bannon and Jon had helped Erin back to the house, a furlong from the cemetery.

"Yes, Mr. Bannon," she said, setting her coffee cup down on the kitchen table. "Forgive me."

"There's nothing to forgive."

"Would you care for some refreshment?"

"Why, thank you, ma'am," he said. "Now that you mention it, I'm about as dry as the dip-stick on a '57 Chevy."

"Beer, Mr. Bannon?" Jon said, opening the 'fridge.

"It's a bit early, but you talked me into it. 'For what we are about to receive, Lord make us thankful.' "

"I want to thank you," said Erin.

"Whatever for?" Bannon said, as Jon placed a bottle and glass in front of him.

"For not having us arrested. Technically, we're both guilty of assault with a deadly weapon."

"That may be true, ma'am. But let's just say there's no harm done and keep it to ourselves."

"That's very gracious of you, sir," Jon said, walking around the table and sitting down next to his wife. "I'm not at all sure I'd be that generous if it happened to me."

"You know, son," Bannon said, after taking a long pull from his brew, "once you get a few years under your belt—now, indulge a senior citizen for a moment—and come through more scrapes than bear thinking about, you'll learn that it seldom pays to bring in the police if you're not physically injured. But that's for another time. I'd say that, right now, you folks have some sort of tale to tell. Am I on target?"

"Yes, sir," Erin said quietly.

"I'm not certain I know where to start," said Jon.

"Nonsense," Bannon said, grinning. "Of course you do."

The Volvo station wagon slowed to a dusty stop.

There was a small spring-fed pond encircled by willows, frogs, and a swath of cattails occupying a quiet hollow. To the west, an abandoned, overgrown, early nineteenth-century limestone quarry perched picturesquely just over the property line. A large forlorn farmhouse with high ceilings and hardwood floors stood on a gentle rise and shared ground with the ruins of a stone henhouse, both on antebellum foundations, circa 1832. Water came from a crystal-pure well. A diminutive private hilltop cemetery lay in the wake of a hedgerow. All this and a line of tall ancient trees shading a mile of winding lane.

Jon and Erin Somners couldn't believe their luck.

They'd met at a skeet range, of all places. Jon had watched as a petite redhead took the firing line, wielded a Weatherby 12-gauge like an Olympic medalist, beat him 24 clay pigeons to 21, then turned and grinned at him. He wasn't sure what had most astonished him: her formidable skill, or her curious smile. He quickly loved her for both. For her part, Erin had been intrigued by a slim, wiry, dark-haired young man with clear intelligent eyes, who was in no way intimidated by losing a match to a woman. Attraction was mutual and proved inevitable.

A few weeks later, he asked and she

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accepted.

It isn't often two mature adults are actually so compatible as to be able to share both a life in which compromise is unnecessary, and a deep personal commitment—not only to each other—but to an old idyllic dream. Now, ten deliberately childless years of long hours, hard work, savings and investment had finally brought that dream to fruition: twenty-five verdant, rolling, wooded acres of southern Indiana countryside. A new beginning. The price? So low it was unbelievable. Traffic, crime, substandard public schools, overpopulation, pace, pollution, and innumerable other pleasures of urban living could go diddle themselves.

God, it felt good to pay cash.

The fallen stones of the henhouse were soon reassembled to become a two-car garage. Restoring the exterior of the farmhouse to its authentic simplicity turned into the proverbial labor of love. Months spent remodeling the interior to ultramodern comfort, including a stone fireplace, top-flight wood stoves, auxiliary solar heating, photovoltaics and a Jacuzzi, swept by with the new leaves of spring into mid-summer.

By the first week of July life and luck had been framed by solid accomplishment. The land, pond, and trees, left pristine. The new/old outbuilding was perfect. And the farmhouse was truly home. They took the time to celebrate, making exquisite love under a huge, honey-and-amber harvest Moon; hopefully conceiving the child they had always wanted and felt they could now afford. Their love had never held more meaning.

The next night fit anyone's definition of "different."

"The ship is vectored in," said G'ort, over the CommNet. "C'elb will handle HOPE."

"That man is an artist," someone said in back.

G'ort glanced along the reclining circle of seats and saw that everyone was in the proper place, wired-in to the master console. Yes, everything was ready. He could suppress a smile no longer.

There was little chance that the ship would be spotted, either near the ground or by any of the crude native detection devices. The ship's drive would play hob with any electronics near the surface, of course. Besides, what rudimentary "stealth" technology this planet possessed was merely the glimmerings of what could be done by a truly developed civilization. They did have those wonderful animations, though, called cartoons. Brilliant. *Boris Badenov & Natasha Fatale.* Marvelous.

But it was time for some real fun, now.

"Stand by!"

Check list: Complete.

"Ready!"

C'elb smiled at G'ort in the pilot's station.

Program: Execute.

"Yeeeeeeeeee EEEEEEEEEEEEE-HAAAAAAAAAaaaaaaaaaa . . . !"

The day's swelter began a leisurely retreat from the evening breezes as Erin stepped out onto the porch and sat down on the antique swing. It was Jon's turn to wash the dishes. So she had left him to his chore and gone out to savor the

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night winds. Twilight seemed unblemished . . . save for odd noises she thought she heard issuing from the end of the lane. Its gravel curves snaked around the pond and passed the hill of the cemetery. Erin was sure the sounds were growing louder.

"Jon, would you come here, please?"

He came to the doorway wiping his hands on a dishtowel.

"What is it?" he said.

"You tell me. Listen."

The pop-pop-pops and muddled clatter, mixed with what sounded like distant voices, became evident to him.

"I wonder what that is?" said Erin.

"Probably just some kids letting off steam," Jon said.

A full Moon slowly arched above the treetops, as the noises clearly developed into discernible shouts and gunfire. Jon glanced at Erin's puzzled expression, seeing—he didn't doubt—a reflection of his own.

Two horses burst from the hedgerow and galloped down the slope of the eastern hill. Skirting the edge of the pond, the riders swayed precariously as their mounts stumbled and skittered, scrambling for better traction on the uneven terrain. A rifle crack echoed in the stone quarry and the nearest charger went down like a poleaxed steer in a slaughter house. Both horse and rider lay motionless.

Erin screamed.

A chill spiked Jon as he watched. The remaining horseman put his head down instinctively and dug in his heels. The roan mare fairly flew across the turf towards the farmhouse.

"They're coming!" the rider shouted, careening to the verandah, reining up so violently his steed nearly sat back on its haunches. He dismounted and ran up the old limestone steps. "They're coming!"

What in the blue-eyed buck naked hell is going on around here? Jon thought.

The fellow jabbered incoherently and thrust what looked like a large handbill into Jon's grasp:

Executive Department
Indianapolis, July 9, 1863
General Military Orders

Satisfactory evidence having been received that the rebels have invaded Indiana in considerable force, it is hereby ordered and required that all able-bodied white male citizens in the several counties south of National Road forthwith form companies of at least sixty persons, elect officers, and arm themselves with such arms as they can procure. Said companies will perfect themselves in military drill as rapidly as possible and hold themselves subject to further orders from the department. It is desired that they shall be mounted in all cases where it is possible.

The people in all other parts of the state are earnestly requested to form military companies and hold themselves subject to orders. Prompt reports of all organizations should be forwarded by telegraph.

All officers of the Indiana Legion are charged with the execution of this order, and all United States officers are requested to

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render such assistance as may be in their power.

O.P. Morton
Governor of Indiana and
Commander-in-Chief

The paper itself felt odd—heavy, coarse, curiously old, just like the phrasing of the message. Yet it all looked brand new. Jon could even smell the ink that smudged under his thumb.

Nothing has made sense, so far, thought Erin. *Why should this?*

Neither did the man's unusual clothes: the dusty calf-high boots; the torn, sweat-stained blue tunic; his disheveled cap and insignia. The side arm? The horse and tack?

Cavalry? Union Cavalry?

"What's going on around here?" Jon said. "And who are you?"

"Corporal Frederick Small, Company 'C,' 83rd Regiment, Indiana Volunteers," he said, panting. "Your pardon, ma'am. What do you think is going on, friend? You blind and deaf? REBS! MORGAN'S RAIDERS! Holy Hannah, it's Katy bar the door!"

I'm talking to an escaped mental patient, Jon thought.

"Erin," said Jon, "call the police."

"What?" she said, then ducked inside. "Yes, of course."

Jon physically blocked the doorway after her.

"I don't know what this is all about," he said, facing the strange man. "But I'll find out before I move an inch."

A rifle retort rang out as the porch light shattered. Both men dropped to the deck.

"Sir," the corporal said, peering fearfully in the direction of the lane, "with your permission, may I respectfully suggest instead we go inside?"

"Yeah," a startled Jon Somners replied. "Maybe that's a good idea." They crawled through the doorway and Jon locked the security door behind them. Erin rushed to her husband.

"Jon, are you all right?"

"Still kicking, honey."

"Sorry to bring all this on you, folks," the uniformed man said. "We just saw your lights and blundered in. It's any port in a storm."

"Huh?"

"I tried to call the sheriff's office," Erin said, urgently, "*and* the state police. The line is dead."

"What?"

"No dial tone. Nothing."

"Pardon me, ma'am," the stranger said, "but I've got to tell you: those bastards cut the telegraph lines and tore up the railroad tracks on their way here."

"Who?" said Erin, bewildered. "Jon, what's going on?"

"I've no idea," he said, and turned to their unannounced guest. "What's this lame excuse you're trying to foist on us?"

"It's right out there, folks," the corporal said. "Take a look."

Beyond the new picture window the lane shimmered with shapes and air grew still as the Styx. Darkness augmented by the foliage of the trees was broken only by dispersed moonlight. Yet the heat of the day had returned and clung like a humid shroud. A methodical beat of hooves throbbed viscerally at the heels of a creaking of saddles and the jingle of bits. Three anxious people

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watched in amazement as clouded forms of mounted troopers, sabres glittering in the moonglow, rode down the twisting lane in a gray, clattering, column of twos.

Orders were bawled.

The ranks of cavalry peeled off. They surrounded the house, coming to halt and dismount on command. There was an oppressive aroma of dung, oil, leather, and sweat.

A "Stars & Bars" battle flag fluttered in a breeze that wasn't there.

"Those boys mean business," the soldier said. "Our patrol came under skirmish and they chopped us off at the big knobbies. Captain Wolford told Isaac and me to ride for it. He stayed behind. But Morgan's here. So, I reckon—"

And with that he drew his side arm.

Neither Jon nor Erin had ever seen a .44 cal. 1858 Army Remington outside of a museum. No leeway existed for a brand new specimen in their living room. A revolver is just that. Jon was naturally wary of anyone else handling firearms in his home, other than Erin and a few trusted friends.

Erin sensed it, too.

"Where are you from?" Erin asked him, as he crouched by a lower sill.

"Corydon, ma'am," he said, "the old capital."

"Is your family still there . . . ?"

She's distracting him, her husband thought. *Bravery, thy name is woman.*

Taking advantage of his wife's actions, Jon reached adroitly round a window drapery and came out with Erin's shotgun.

"All right," Somners said, holding the smoothbore waist high, "the show is over. Now, you can take yourself, plus the rest of the local chapter of the Society of Creative Anachronism, and get off our property!"

"You've got it all wrong, mister," the warrior said, dropping his revolver, its muffled thunk absorbed by the thickly padded carpet. "Unless you're a rebel sympathizer, I'm on your side."

"My side?" Jon said. "I'll say this for you: you're consistent. You and your friends are playing it to the hilt. I'm impressed."

"They're not my friends!"

"They're sure as hell not ours!"

Erin cut in: "Friends don't shoot at your house—"

Outside, the circle of guerrilla horsemen prowled and probed amid the shadows and gullies.

An eldritch voice bellowed: "Ready!"

"And play incredibly elaborate hoaxes—"

"Aim!"

"And take us for fools—"

"FIRE!"

The ensuing fusillade imploded the windows and pocked the newly finished walls with a veritable hail of small arms fire. The people inside the farmhouse plunged for the wall-to-wall carpeting.

"Come on out, blue bellies!"

"Damn Abe Lincoln and God bless Robert E. Lee!"

Trooper Small sat up wounded. A sharp odor of blood began to fill the room. It combined cloyingly with airborne dust and the scattered shards of glass in the now darkened house. Small reached for his .44, cocked it, and squeezed off a shot through the ragged

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edges of what was left of the window.

"You go to hell, Johnnie Reb!" he cried, coughing.

The Confederates interspersed a variety of comments in response, some profane, others jocular, between whoops and yells.

This is real, Erin thought. *It's impossible. But there it is. Bullet holes and all. Somebody is trying to kill us. Why? I don't know. There's no time to think of reasons. We have to stop them. What is Jon always telling me? First things first.*

"Jon," Erin said, "give me my shotgun."

He tossed it to her and she caught it in practiced hands.

"Damn it," she said, "this is our home! We've worked years for it. No one is going to attack us, or our life's work, and get away with it."

"I knew there was a reason I loved you," Jon said.

Somners bellied over the floor to a locked cabinet in the corner. He fiddled with the combination and pulled open the tang when tumblers finally fell into place. Removing four boxes of 12-gauge shells, shot and slug, he tossed two to Erin, along with her bandolier hunting belt. He returned his attention to the cabinet and retrieved a complete first-aid kit. Then he slipped his customized .45 automatic onto his pants belt, and took out the Franchi SPAS 12 shotgun. He loaded its tube with a full seven rounds, then chambered an eighth.

Jon drew a deep breath, and crab-scuttled over to Small.

"I never saw a piece like that before," the corporal said.

"Uh . . . my own invention," said Jon.

"Nice."

"Thanks."

The wound wasn't serious. So, it was relatively easy to stop the bleeding. Somners succeeded in jury-rigging a quick field dressing to Small's scratch, while Erin took roaring potshots and dubious hits at darting shadows outside. Return fire was sporadic and mixed with derisive laughter.

Great sports, those fellows.

So much so that orange flickers appeared at the back of the house.

As flames tongued the walls, all three opened fire. The effect they were having on the situation seemed questionable, at best. Yet it felt good to be taking direct action in response to a real threat, no matter the outcome.

Still, there ain't no such thing as a free lunch.

"We can't stay here," the soldier admitted for them, at last. "It's been nice meeting you people." He struggled to his feet. "Sorry it wasn't more fun. Your servant, ma'am," and he stepped through the destroyed picture window into the night, firing rounds with every stride. The couple called out to him. But the sound of their voices drowned in cumulative gunfire, as the cavalryman was scythed in slow motion.

The Confederates redoubled their attack. Smoke grew thick and billowed from the latices and skylight. A ring of figures tightened their circle around the conflagration.

"What now?" Erin gasped.

"The storm cellar," said Jon. "Quickly!"

Concealed in the kitchen floor, the cellar door opened to Jon's tug. They

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leapt down the stone throat and pulled the hinged portal after them. Acrid smoke rose but fumes leached through. They began to loose consciousness, as a cacophony of battle raged overhead—and a child wailed plaintively in the nebulous distance.

Erin wept to hear its pain.

"That was the best run yet," said J'apt. "Great data."

"An excellent reenactment, indeed," K'lee said.

The party was well under way even before rendezvous with the mother ship, toasts in iced claret and all. The noise was utterly delightful.

"I wish I could see their faces in the morning."

"Well," K'lee shrugged, "maybe next time."

Morning and silence.

A lethargy unlike any they had ever known sluggishly fell away and sunlight filtered through the floorboards. Memory returned in tightfisted traces triggered by a sour smell of residual gases and rancid sweat. As the two people embraced, they discovered a pair of soot-smudged, slovenly mortals with superficial lacerations and the pain of aged eyes.

"Let's get out of here," Jon said, with a rasp.

The cellar door gave way easily. That was their first surprise. Trudging up the stairs to the kitchen, minds apprehensive, spirits trembling, they confronted surprise number two: the house was intact. Nothing burned. No shattered glass. No blood. Except for the open gun cabinet, there was nothing which gave evidence that anything at all had happened. The paint, wood stain, carpet and brass, still looked and smelled fresh.

"Am I crazy?" Erin said. "Or did we hide for our lives?"

"We hid," said Jon. "With damn good reason, too. Let's try outside."

The day was perfect, warm, few clouds, with a cerulean sky so clear and clean it pained the eyes to look. Leaves and branches rustled in the morning breezes. And no bodies. No horses. No spoor. Not a clump nor tuft of grass out of place.

"This makes no sense," Erin said.

"Maybe we missed something," said Jon. "Where did we first see them?"

"The hedgerow."

Croaking amphibians and jumping fish splashed in the pond as they purposefully made their way up the hill. Daylight wove through the web of trees. They still carried their weapons. An impression had been left upon them, in fact, if on little else. Yet they saw nothing tangible to support their fear, their submerged terror.

"Come on," said Erin, "we'll check behind the hedge."

"Are you sure you want to know?" Jon said, pushing through.

"What do you think?"

"Lead on, Macduff."

The cemetery was still, in shadows, and decidedly cool. Disturbingly so. The headstones seemed moist and terribly ancient, the mold of nearly three centuries on more than one. 1764. 1786. 1798. No sign of hooves. 1803. 1821. Not even a buckle. 1839, 1847. 1856. . . .

"Jon! Look!"

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The weathered limestone marker stood simply and alone:

FREDERICK SMALL
A Corporal of Company 'C'
83rd Reg. Ind. V.L.
+
Died: July tenth 1863
23 yrs. 2mos. 26ds.

Afternoon sun streamed lazily into the kitchen through immaculate windows and danced reflectively from the bottle-glass in front of three tired people, sitting in silence as after a storm.

"We heard you praying aloud, Mr. Bannon," Jon said. "When we went to investigate, you rose up from behind your wife's headstone—"

"And you took me for a corpse?"

"Nearly made you one."

"You think we're crazy, don't you?" Erin said. "Just two strangers from the city who were drunk or on drugs. Right?"

"No," the old man said quietly. "You're not crazy."

Jon and Erin were thunderstruck.

"You believe us?"

"Of course, I do."

"No offense, Mr. Bannon," said Jon, "but if I were you, I'd be skeptical as hell."

It was Bannon's turn to be shocked.

"You mean, you really *don't* know?"

"Know what?"

"What every schoolchild in this county knows," Bannon went on. "Every generation for more than a hundred years."

"And *that* is?"

"Your entire property is *haunted*."

Silence.

"I thought you knew," Bannon said. "Everybody else does."

"You're serious," Erin said flatly.

"Is there any other explanation for what happened last night?"

Erin and Jon sat nonplussed.

"I need another drink," said Jon, heading for the refrigerator.

"Me, too," said Erin.

"Draw three," Bannon smiled.

As he returned to a numb wife and a most jovial neighbor, Somners remarked: "You don't seem put off by it, Mr. Bannon. May I ask why?"

"Oh," Bannon said, "you'll get used to it."

"I don't see how," Erin said. "In fact, I don't ever want to go through that again."

"You won't have to. First of all, it only happens once a year. The previous owners—the Parkers, awfully nice people—always took a vacation about this time. You might do the same. Nothing is ever damaged, really; nothing is truly disturbed. That's a fact. And a beautiful plot of land it is, otherwise."

"Other people have seen it?" Jon said.

"Oh, yes," said Bannon. "I've seen some of it myself. Years ago, of course. It's become sort of a rite of passage for young boys to come out here and see what there may be to see. Young girls, too. But that's a double-edged sword. You know young boys."

"Is it always the same?" said Erin.

"Mostly. Some people see only glimpses or snatches of it. Some claim they don't see anything at all. You folks were lucky."

"Lucky?"

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"Sure. First time out and you saw the whole show."

Quiet.

"What's behind it, Mr. Bannon?"

The old man paused for his beer.

"On July 9, 1863," he began, "Brigadier General John Hunt Morgan led his Raiders from Kentucky across the Ohio river and into Indiana. The ol' boy claimed it was to take the war to the Yankees. Well, that he did. They cut a burning path along the southern hills, all the way into the Buckeye State. Historically, it was one of the few actions of the Civil War to take place north of the Mason-Dixon line."

He pulled at his brew, again. "Thirsty work."

They smiled.

"Anyway," he went on, "the Confederates caused considerable damage, and more than a few deaths. Some even say it didn't happen: that Morgan and his men never killed civilians. But his second-in-command, Colonel Basil W. Duke, admitted in his own book that they burned at least *one* residence; although, he didn't say *where* in Indiana, exactly. But we know. Don't we?"

"Just what *did* happen, Mr. Bannon?" Erin said.

"Well," said Bannon, "wherever Morgan went, bridges, depots, watertanks, etc., were burned and the railroad tracks torn up. It seems that looting and pillage were his troops' main sideline. They took everything that wasn't nailed down. Strange things: bolts of calico, country hams, empty bird cages, bread off the tables—quite literally—not to mention all the horses they could lay hands on. Contrary to popular opinion, there's really not a whole hell of a lot of honor among thieves. So, Morgan—the 'King of Horse Thieves,' himself—behaved contradictorily upon occasion. Once, after looting a local Masonic Temple, he gave some of the boodle back to a few of the more influential outraged citizens.

"But around here, he was all war.

"Those two couriers were chased several miles. The number of Rebs after them depends on who you quote: more than 1, less than 100; you know how that goes. But think about it. Two men hounded to hell and gone by whatever size Confederate detachment it really was, the whole pack. Corporal Small was cut down singularly, and the Lathropt family, all of them—James, Katherine, and little Anne—burned to death.

"A fair fight? Not even a cut-slash-and-run scoundrel like Morgan claimed that. No, sir. Even in war it was murder, pure and simple."

One last pull, then empty.

"So," Bannon said, at last, "this time of year—or so the local folklore has it—the perpetrators are sent back from 'The Pit,' to the scene of the crime, in order to work off their sins. Well, maybe. And maybe not.

"Who really knows?"

"In a rational universe," G'bett was saying, "if all that was needed was bold strategy, brilliant tactics, dedicated soldiers, a whopping thump of luck, and the uncommon courage of a true gentleman, not only would Lee have been victorious at Gettysburg but, with Longstreet, Jackson, Stuart, and A.P. Hill, he'd have won the war for the South."

"Indeed," said B'ult. "But war is

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not rational. It is often merely necessary. Even though armed conflict is by no means trivial in itself, it *can* be decided by trivialities. With time, the great distinctions between victor and vanquished blur in the end. Because both share a commonality of experience the protected never know."

Nor do we, K'lee thought, try as we might.

"Blockades, sieges, and cannon factories made more difference . . ."

The chairman left the discussion.

K'lee needed to think. There was much to be said for this primitive civilization under study for so long. True. Even at its worst, there seemed a smouldering ember of pre-fanned flame, a spark of energy, an undefined visceral something that his own people appeared to be losing.

If it hadn't been lost already?

Perhaps next time they might attempt direct emotional connection with the natives involved, if that proved possible. It was risky, of course, but it could be worthwhile. Maybe then he would be able to understand the incredible desire, the wanton need, to fight for something beyond one's capabilities, even when you know that winning is impossible. If only he could have talked to Morgan or, best yet, to Lee himself. He might then know what it is like to contend in vain. But is it ever a matter of being *truly* in vain? Could it possibly be—

"Mr. Chairman?"

K'lee turned and saw the eager face of T'obb, the new first year.

"Yes," K'lee said gently, "what is it?"

"I've been wondering about a couple of things, sir. For example, why reenact such a minor action as the Morgan Raid? The outcome of the war certainly didn't hinge on crossing the Ohio."

"Of course not," K'lee said. "But it's more our size. You see, T'obb, the great so-called set-piece battles—such as both First and Second Manassas, Shiloh, Antietam, Fredericksburg, Chancellorsville and, of course, Gettysburg—were huge undertakings. Tens of thousands of the natives were involved, sometimes hundreds of thousands, men and animals, and they moved over multiple square miles of ground. 'The recent Unpleasantness At Gettysburg' lasted for *three days*. Not that such reenactments would be beyond the capabilities of HOPE, but the natives have made national monuments out of most of the battlefields; any activity such as ours, in *those* places, would draw not only immense crowds but commensurate questions and investigation, as well. 'Too much of a good thing,' as it were, eh?"

T'obb nodded in agreement.

"By contrast," K'lee went on, "the Morgan Raid was small—via the standards of the day—and moved linearly, on a traceable route. Our 'incident' occurred at a spot that was out of the way *even then*. And so it remains. Besides, few remember the raid now. History does not appear to be a general strong point among the natives. Our safety lies in the obscurity of our choice."

"I see what you mean," said T'obb.

For a moment, and only for a moment, K'lee saw himself in the eyes and demeanor of the new first year. An unfamiliar feeling touched the chairman. Then it passed. And the present reasserted itself.

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Was that what the natives call nostalgia?

"Is there anything else?" K'lee said.

"Only that I'm still troubled by the spectre of Central Office," said T'obb. "I do have my career to consider, after all."

"Of course," K'lee said, smiling. "By chance, have you heard the name Q'ull?"

"Indeed," T'obb said, sweat forming a cold pool between his shoulder blades. Who had not heard of the Chief of the Examiner's Board? "The Executioner," himself. Young T'obb fought to keep his knees from knocking. "Why do you ask?"

"It might interest you to know," said K'lee, "that Q'ull is a former Chairman of Earth Station Chapter of *The Society of Recreative Anachronists*."

The first year looked as though he had just passed his orals.

"No wonder everyone seemed unworried," T'obb said.

"Well," said K'lee, his grin spreading warm and wide, "now you know why."

Richard F. Bannon polished off his beer and made ready to leave. He politely accepted a raincheck for dinner. Yes, he would make it soon. A good home-cooked meal was one of the few vices he allowed himself, anytime he could get it.

After touring the old/new house, he paused at the verandah on his way out. The afternoon sun tickled the willows and proved the shady worth of the old oaks. Bannon breathed in the sweet and simple scent of a land he would have known in his sleep. He thought about the marvelous young couple behind him, then of his wife, Grace, up on the little hilltop.

Just for a moment, and only for a moment, the years receeded. He was strolling with a lovely young girl who had just shown her first and *only* lapse in good judgment by saying, "Yes," to a farmer by the name of Richard F. Bannon. Then it passed. The present reasserted itself in the form of a strong young man with flecks of iron in his eyes, and a capable young woman with freckles and red hair.

It is right and good, Bannon thought, *all of it. If God made anything more beautiful, He kept it for Himself.*

"Oh, by the way," Bannon chuckled, turning to his new friends, "It's none of my business, but did the realtor quote you a good price on this property?"

"As a matter of fact, he did," Jon said.

"Very good, indeed," said Erin.

"Well," Bannon drawled, his good-old-boy grin wide as a picket fence, "now you know why." ■

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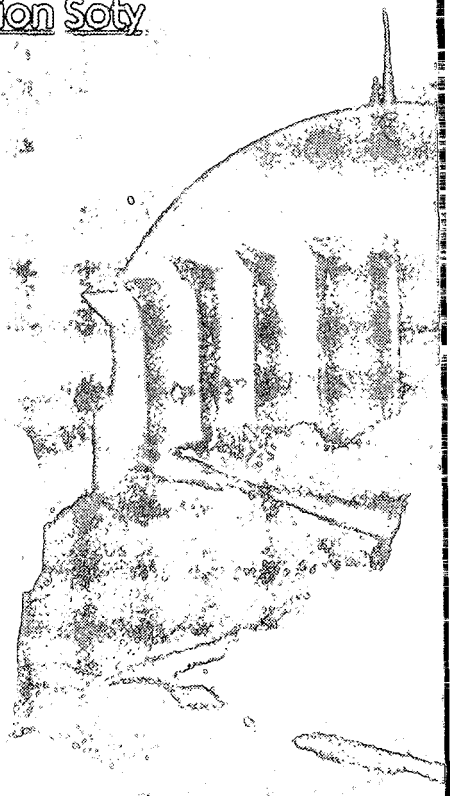
CALL TO GLORY

Francis Marion Soty



The impact of a major discovery depends very much on who makes it. . . .

Tim Stanley

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Abraham Entskilling was working alone on the Friday evening when he made the most important discovery of the new century.

He had gotten up before seven, eaten breakfast alone—Mary never arose that early—and loaded the ladder, lawnmower, edger, and gardening tools into the back of his blue Toyota pickup truck. He spent the morning alone, cutting and edging the grass, and trimming the few short trees at the sides and rear of the Church of the Nazarene Reborn. Two other men on the grounds committee, both retirees, were scheduled to be there, but neither appeared. That did not really bother Abe. He had grown accustomed to working alone.

It was a typical hot, dry Arizona day in June, a brassy sun bringing sweat to his forehead in the first five minutes. Despite the heat, Abe enjoyed the mildly demanding work. At forty-one, he had been letting himself get flabby. He liked the feel of his muscles straining slightly as he lifted a bag of grass to his shoulder, the pulling in his thighs when he climbed the ladder. To his ears the singing whine of the edger, the comforting roar of the mower, were soothing and mentally relaxing. There was a pleasant satisfaction in feeling his body respond to the need to heave the steady accumulation of black plastic bags of cut grass and branches into the bed of the pickup. He was dripping with sweat and very tired when he finished, just before one o'clock, but he felt good. He had cut the entire lawn around the small church, neatly edged the sidewalk in front, and trimmed and shaped every young, struggling tree.

Mary had his dinner kit packed when he reached home, and lunch ready on the table. She ate in the living room, in front of the television; her favorite soap opera had started at one. Abe ate lunch alone, showered, and tried to catch a short nap before leaving at three for the long drive to work. But his younger sister called from Birmingham before he could get to bed. Her fifteen-year-old son had been arrested for vandalism at school, and was going to spend next year in the reformatory unless she paid for the damages. It was a long conversation, and after he finally agreed to lend her another five hundred—she had borrowed over a thousand from him last year—and could hang up, it was too late to bother trying to sleep.

Mary looked up from her second hour-long soap as Abe was leaving. There were only a few lines in her face at thirty-eight, but gray streaked the dark-brown hair, and her plump arms looked soft and doughy. "Have a good shift, dear. I'm going to the mall for a little shopping, and to have dinner with Peggy and Irene. I'll see you tonight."

Abe became sleepy during the hour-long drive on the deserted back road to the observatory, and had to shake himself awake several times. It was a relief to finally see the ninety-meter radio telescope dish ahead, towering above the barren desert landscape like some giant floor fan, ready to start revolving and stirring the heated afternoon air. A two-story rectangular block building and three smaller wooden ones huddled near its base, as though seeking shelter in its huge shadow from the burning sun. The entire complex was surrounded by a

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high chain-link fence. A large sign adjacent to the open gate informed the few visitors that this was the Associated State Universities Southwest Radio Observatory. The once-bright painted letters had been dimmed by years of strong sunlight and sand abrasion. A much smaller sign, attached at the bottom like an afterthought, added that it was also the Billingham Analysis Center for the Search for Extraterrestrial Intelligence.

The SETI offices were located at the rear of the main building, on the second floor. The lone secretary was leaving as Abe arrived, with the two day-shift analysts right behind her. The observatory operated seven days a week, but the always financially strapped SETI program could not afford to match their full schedule.

The local manager was David Collinsworth, a short, plump, retired teacher of astronomy from the University of New Mexico, the only member of the SETI team with a Ph.D. He stayed long enough to brief Abe on the day's events before starting his weekend.

"Finally got caught up, Abe, right down to the three o'clock cutoff here. Several alerts, but nothing solid. You should have a nice quiet evening. And if you happen to leave a few minutes early tonight, no one is going to care. It's Friday! And we're in the best shape we've been in for months."

"Thanks, Dave; I might just do that." But they both knew that Abe would put in his full eight hours.

Collingsworth left, and Abe entered the cluttered operations room at the rear. He settled down at the microcomputer and called up the equations he had started the night before. There was a minimal crew operating the big dish, but they were unlikely to disturb him.

The hours crept by. Abe became sleepy several times, and had to get up and do calisthenics to stay awake. At mid-shift he ate dinner at his desk, as he usually did, without stopping work. The primary analysis computer was highly automated and did not require much attention. The main task of the evening was to run data dumps received from several other observatories in their southwest district that afternoon. It finished them without incident, and Abe called up the data from the big dish just outside. Collingsworth was right. It was unusual to be analyzing data right on the heels of the regular operators.

When the computer sounded its third urgent *"beep! beep!"* within an hour after dinner, Abe looked up in annoyance. He was deep into verifying an algorithm he had worked out earlier that might eliminate some of these false alerts, and resented the interruption.

Abe sighed, and swung his chair around from the isolated desktop micro to the mainframe terminal. The analysis program was designed to hold the suspect data in memory until he had examined it, and a single keystroke brought it on-screen.

And the discovery of the new century looked out at him in quietly glowing green numbers, standing out stark and clear against a black background.

Abe saw immediately why the analysis program had alerted him. The signal was near the center of the waterhole, at 1.55 gigahertz, and only 5 hertz wide; far too narrow for any known source of natural origin. He felt a growing sense of excitement as he examined the data.

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The transmission was in the form of a series of pulses, recorded in small groups. A quick count showed that the first group contained a single pulse and the final one ten, with each group in between holding the number that corresponded to its position in the sequence. The excitement and tension mounted as he realized that the eleventh group was ten pulses again, and then nine, eight, and on down to one. Then the count abruptly jumped to five pulses for the next group and counted down to a single pulse again, repeated the one, and counted up to five, jumped to ten and went down to five, and from five up to ten again.

His hands were shaking slightly. Abe took them off the keys and folded them in his lap, still staring at the screen. The cursor blinked back at him with quiet persistence. The groups of pulses that emphatically signaled "intelligence" waited for him to acknowledge their existence.

There were a few more confirming checks to be made. Abe called up the resources to analyze the characteristics of the signal. As expected, it was on a continuous carrier and drifting very slowly in frequency, indicating it was originating from a rotating planet.

Abe abruptly rose to his feet and walked across the small room to the coffeepot. He filled his thick, deeply stained mug, then stood waiting for it to cool enough to sip. There was so much to do . . . the feeling of excitement slowly changed to one of elation, as it finally sank in that *he* would be the first to announce the discovery. It was only to the second-shift operators at the designated back-up observatory, in Tolson, Texas, but—*his* name on the initial report. This was something he rarely thought about, had not considered a very realistic possibility. He had often heard the other analysts talk about what their reactions would be when it happened—a favorite subject of casual conversation, in which they always seemed to assume that it was only a matter of time—but the whole idea had never been very real for him. This was just another job, one that paid less than the good position his alcoholism had cost him, but certainly an adequate income. Engineers with a background in data analysis never lacked for work, or came cheap. Still, he had been lucky to get his job less than a year after Mary had committed him for rehabilitation.

One of the first things he must do was notify Dr. L'Overture at Socorro. The astronomer would appear in person tomorrow, to physically check the evidence of discovery and verify its authenticity. And then . . . he hurried back to the desk and opened the procedures manual. What he must do was outlined, step by careful step. First was the confirmation process, a detailed list of actions to be performed which he could omit. They were designed to resolve ambiguities and uncertainties where intelligence *seemed* to be present; here there was no doubt. Second was a whole series of other observatories to be notified after Socorro, all in the northern hemisphere . . . the duplications, then isolation and preservation of the original signal . . . And Mary! He had to call Mary! His own wife should be among the first to know. . . .

Abe realized that his heart was pounding, and he was breathing fast. He

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folded his hands on the desktop, bowed his head, and did what he knew he should have done first of all. He prayed for strength and guidance.

Prayer calmed and soothed Abe, as always. He spoke to God at length and out loud, since there was no one present to object, thanking Him for letting someone as unworthy as Abraham Entskilling be the finder of this long-sought holy grail of science. Now his name would be in the history books, though he was only a lowly engineer, not an astronomer or important scientist. The first human being to see the unmistakable imprint of an intelligent signal from another star system. . . . He had a sudden thought, finished the prayer, and returned to the mainframe terminal. How long ago had that signal come in?

The telephone rang. Almost convulsively he grabbed for it, and said hello. He did not identify himself; crank calls were common at SETI observatories. It seemed almost impossible to keep the telephone numbers from getting out to the UFO fanatics.

"Honey? I just called to ask you to stop by for milk on the way home. I'm sorry I forgot, but I don't want to go out alone now. That swifty-quicky on Zeeman Road will still be open."

"Mary . . ." he started to tell her, to share with her the importance of this discovery. But instead he paused, then said, "Sure dear. I know you need your bran cereal in the morning. I'll get the milk."

"Thanks; I won't keep you from your work, then. I may be asleep when you get in."

He said good-bye, and slowly replaced the phone in its cradle.

It took only a few minutes to search ahead through the data run from three o'clock to the present, and confirm that the signal had been repeated twice, at intervals of just over an hour. The first one had arrived during the last hour of the day shift. The next two came in between four and six o'clock. There had been none since, and it was now ten till ten. Based on the time sequence between the initial three, at least four more signals should have been recorded. That meant the unknown originators had probably moved on, sending their series of three sets of identical, carefully numbered pulses to another star. There was no way of knowing when, if ever, their transmitters would focus on Sol again.

So the most important discovery in modern history would have to stand on the weight of his signal alone. Abe had a sudden thought, and called up the Friday observing program. That was set by the main observatory; SETI was a hanger-on, a secondary user of the data, as the added small sign at the main gate clearly symbolized. Its computers were specifically designed to seek and find the signatures of intelligence, hiding among the natural radio voices of the stars. Until now, it had been a long and frustrating quest. . . .

The identification of each star observed was an automatic function of the operation program. This one had an NGC number but no name. It was a G2, located at a distance of eighty-one light-years, very low on the horizon to the north. The signal strength was right at the end of the range of this huge dish; out of hearing to any smaller ones. And . . . a quick check of star positions and the observing schedule confirmed

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what he suspected. By tomorrow morning that star would lie within the interference cone of the Sun. After tonight it would not be visible again for several weeks. That was one of the reasons the regular radio astronomers had targeted it for today's run.

Abe sat and tried again to concentrate, holding the feeling of excitement in check. The habit of extreme caution had been drilled into all SETI analysts from their first job interview. The Society for the Search, their only financial backer, had emphasized that a single announcement later proven wrong could cause their sources of funding to dry up. There was no hope of getting money from the UFO fanatics; they supported their own peculiar causes, not real science. The government-sponsored SETI program had died a decade ago, in the early 1990s. The Planetary Society was still operating their independent system in two South American countries, but their antennas could not see this northern star. If he was wrong, and this was some man-made interference, or had an overlooked natural explanation. . . .

No; that was virtually impossible. He felt certain that the authenticity of the three transmissions would stand up to the most rigorous examination. Of course he could always be accused of having manufactured them. . . . That would have been relatively easy to do, a hidden manipulation of the recorded signal. . . . No, the regular observatory computers would have copies of the original run. It could be extracted again by the special purpose SETI computers, if he was accused of faking the data.

Abe's first sense of exhilaration had cooled. He had been a SETI analyst for three years now, but had never thought seriously about the full implications of this discovery. There had seemed little need. . . . The UFO crowd would feel that all their nonsense had finally been confirmed. If another civilization definitely existed, then they were regularly visiting the Earth. The nut fringe would never believe that the clear pattern and timed transmissions indicated an intelligent and planned search via the electromagnetic spectrum. The fact that the senders were purposely transmitting radio signals made it highly unlikely that they had mastered interstellar travel. Who would bother with a radio search, if they could fly between the stars at better than the speed of light? Eighty-one years was a long time to wait for an answer.

And what effect was the announcement going to have on his church? On all the other major religions on Earth?

In the end Abe did go home an hour early, leaving at eleven. He needed more time to think, to consider all the implications. There was no hurry; the signal would be as authentic on Monday as it was today.

Mary was already asleep when he arrived at midnight. He had just returned to the small living room when the telephone rang. He reached it quickly, before the noise could awaken Mary, and kept his voice low. "Hello."

"Abe? Abe, this is Harry. Abe, I . . . I slipped a little tonight. It's Friday, and Angela's with our daughter in Tucson. That baby coming, you know. I ate at The Tender Steer, and after dinner I just didn't want to go home. Abe . . . I had two drinks at the bar afterwards. There's a third one sitting

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at my place, untouched. Abe, I need help. I hate to ask it, but could you—"

"Don't touch that drink!" Abe said quickly and sharply. "Listen, Harry, I'll be there in ten minutes. Just pay your bill and wait for me outside. Outside, understand. I'll be driving my blue pickup. Ten minutes, Harry."

Harry promised, and they hung up. Abe still had his keys and billfold in his pockets. He hurried back to the truck and drove rapidly to the restaurant and bar, on this same side of town. He was Harry Comforter's sponsor in the local chapter of Alcoholics Anonymous, the one the newer member was to call when the temptation to take a drink grew too strong. A second member was supposed to accompany Abe when responding to a call for help after drinking had started, in case his own resolution grew weak, but he knew that was unnecessary. It had been over four years now since Abe had taken a drink, and a long time since he had felt compelled to make such a call. He prayed for help in resisting the temptation instead; for him, that worked equally well.

"God, I'm glad to see you Abe," Harry said as he climbed inside the truck. "I did what you said, left that third drink. But I didn't want to. My God, how I didn't want to! You . . . well, you know."

Harry seemed completely sober and shaken at how close he had come to starting a drinking binge. He was a newcomer in the chapter, with less than a year of sobriety behind him. A man of just over fifty, he was overweight and in poor condition, with puffy cheeks and thinning blonde hair. Harry was a buyer for one of the big department stores at the local shopping center. He had reached the point where his career was about to come crashing down around his head when he joined AA, and found the help he needed.

When they reached his house Harry begged Abe to come in and talk with him for a time. Abe agreed. They sat at the kitchen table and drank coffee for an hour, until Harry finally said he thought he could fall asleep. He would be OK again in the morning. They prayed together, taking turns speaking, thanking God that Harry had found the strength to resist that third drink, to call Abe, and avoid the drinking spree that would likely have cost him his job. Abe thanked God for letting him be his instrument in the saving of a fellow human being from the merciless grip of alcohol. Harry looked truly relaxed and at peace again when they finished, and Abe had no difficulty believing that he was really going to bed.

It was almost two o'clock when Abe pulled into his driveway again. He needed another shower, but was so tired he decided to postpone it till the morning. He quietly changed into pajamas and slid into the big waterbed beside Mary. She was breathing heavily, as usual, but the slight noise could not keep him awake for long.

In the morning Abe read everything worthwhile in the newspaper, while dawdling after breakfast over a second cup of coffee. Mary left for a ten o'clock meeting of the church fund-raising committee. Restless, he turned on the television and tried to find something worth watching. Saturday morning TV was a desert of a different sort than that surrounding him. He turned it off and went

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to his workroom, where he passed a satisfying two hours working on an old microcomputer he was slowly upgrading.

After lunch the restlessness grew stronger. Abe tried not to think about the signal sitting in his machine at work, but it kept intruding into his mind. So *much was going to change . . . the faith* of the weaker members of the church was going to be severely tested. If a Kardashev I type civilization existed eighty-one light-years from Earth, one fully equivalent to their own—were they still God's chosen people? He had no doubt of it, but others would wonder. Were there people on planets around any of the thousands of other stars within that immense range? Could God really be always present over that vast an expanse? Listening to all those potential trillions upon trillions of beings?

Abe abruptly got his keys and billfold. There was no possible chance of a mistake, but suddenly he wanted to see that signal again. He left a note telling Mary that he was going out to the observatory for an hour or two.

He drove slowly through the quiet countryside, in no hurry. There was one person passing through the small lobby when Abe arrived, and he said a casual "Hello" as he headed up the stairs.

He called up the signal again and studied it. Then he went back and retraced his steps, from verifying the origin to rechecking the search algorithms that had located and isolated the signal. There was no mistake, no doubt whatever. This was a deliberately sent message from another star system, an effort to communicate, transmitted by intelligent beings. They were letting the inhabitants of this system know that other sentient life existed, that they were not alone in the immensity of the Galaxy.

Abe sat staring at the screen. He tried to concentrate on the implications of the coming announcement, but the tranquil face of Harry Comforter kept intruding. The peace Harry had reached after they *had prayed together, the strength to pick* himself up and start over again on keeping his sobriety. . . . The members of his church, all good people trying hard to live decent Christian lives. . . . And all the other poor weak people of the world, those who had a difficult time making it through each day without God's help and guidance. . . . Would their faith be strong enough to survive this shattering revelation of science?

Slowly Abe's fingers began to move across the keyboard. He located the first appearance of the signal and removed it, leaving a small blank in the otherwise seamless pattern. Such tiny glitches were not uncommon; no one would notice it, even if another analyst happened to look at this data. He located and erased the next two as well, and on the last one, closed the hole by bringing the remaining material in to fill the gap. Now there were only two tiny vacancies in an immense recording of radio noise.

The backup copies were easily destroyed. He copied old data over both of them, to be certain they had been thoroughly erased.

It was done. The SETI records would show a complete analysis of the second-shift run, with the usual result—nothing to report. No one would ever again run the original data through the SETI computers. There was always too much new

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material to process, too much other work to do.

The Sun was still far above the western horizon when he headed home. A steady wind out of the northwest was blowing hard enough to send swirls of sand across the dark macadam road. Going to be another hot, windy night. The air conditioner purred as it successfully fought the desert heat, keeping the cab comfortably cool.

Abe thought again of Harry Comforter, the other men and women in his AA chapter, and the three hundred or so members of the Church of the Nazarene Reborn. They were safe now. There would be no shattering news in the paper that would make it difficult for them to maintain their faith in God. . . . Had his own been shaken? He admitted to himself, finally, that it had been, at least for a moment. And he thought of himself as strong, secure in his beliefs. What might have happened to weaker souls?

Abe felt a gathering pressure low in the back of his head, sure sign of a serious headache coming on. His foot had been pressing the gas pedal harder as he mulled over the possibilities. He did not normally drive this fast, but it felt good to be bucking the growing wind, fighting to keep the truck on the narrow road. Could those distant Kardashev I beings really worship the same God? And all those uncounted stars within eighty-one light-years . . . the untold billions beyond in the immense reaches of the Milky Way, and nearby the Magellanic Clouds, and yonder giant Andromeda, and all the other galaxies. . . . He closed his eyes as the first excruciating stab of pain seemed to penetrate his head from back to front, but opened them again immediately. He should slow down; going too fast on this barely visible road. . . . Hellman's Gulch just ahead on the right, only a few yards distant as he rounded a gentle curve. . . .

That signal still existed, hidden in the observatory's data file for yesterday, but only Abe Entskilling knew it was there. If the glamor of fame tempted him, broke his strength, made him reveal it . . . the devil lured the weak in many ways, and adulation and glory were among them.

The truck started around the last stretch of curve, with the accelerator near the floor. Abe had not known he was going to turn the wheel until he felt it moving in his hands.

The light truck left the road on the right, momentum carrying it on over the sun-baked sand at breathtaking speed, the sharp edge of the gulch appearing ahead, clearly visible despite the blowing sand. . . . Engine roaring as the wheels lost traction, the pickup went out and over the edge, briefly flying through the brown and tan of the roiling dust, the nose of the truck slowly tilting forward as it started to fall . . . the world was safe for Christianity now . . . he was human and weak, but God was strong. . . .

The pickup hit the bottom, only twenty feet deep, on its nose, and cartwheeled forward, slamming again and still again into scattered rocks and pockets of sand. Abe's last conscious thought was that he had left that note for Mary, and the searchers would easily find the truck in the morning, when the wind died. . . . ■

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The Alternate View

JUNK, CULTCH, AND TOOLS

G. Harry Stine

About every year (or thereabouts) I am forced by necessity (lack of space) to clean out the Nitrosyncretic Laboratory. This is my workshop. In it, I can and do handle electrical work, electronics construction and repair, plumbing maintenance and repair, light carpentry, light aircraft parts maintenance and repair, model rocketry, sport rocketry, 1:72 scale plastic model airplane construction, computer repair, and automotive component maintenance and repair.

The workshop is my refuge from the word processor.

It is also my link with reality.

About 40 years ago, the former editor, John W. Campbell, Jr., told me that he pursued the hobbies of ham radio, electronics, crystal growing, and a few others. He advised me that a science fiction author should have one or more hobbies that required one to deal with the *real* Universe.

He was right.

As a result, my workshop has taken on a life of its own because it is a living entity. It grows. When it grows to the point that I no longer have space on the work benches and have to wend my way through boxes full of this and that, it becomes mandatory that I do a clean out.

This is always traumatic.

The first task is to separate *junk* from *cultch*.

Junk is composed of those things which are clearly and obviously beyond any possible utility—empty cardboard boxes, pieces of wire often with terminal lugs on them, three-year-old hardware store receipts, burned out light bulbs, dead batteries, assorted screws and nuts that are corroded beyond recognition, pieces of scrap wood, pieces of metal, pieces of plastic, empty spray paint cans, broken fan belts, some kind of semiconductor whose source I cannot remember and whose condition is obviously *kaput* or it wouldn't be littering the bench, shop rags eaten away by battery acid or covered with dollops of silicone or paint, dead bugs, a hammer with one claw broken off, a stripped-down floor fan whose electric motor I intended to rewind two years ago, slightly used model rocket engine casings, and plastic pool whips with numerous holes in them.

Cultch, on the other hand, is an old New England term for "useable junk." Cultch is that little piece of brass with two holes drilled in it that came out of something long forgotten. It might — just *might*—be useful at some future time when a piece of brass with two holes drilled in it is an absolute necessity at ten o'clock on a Saturday evening when I'm in the middle of fixing something. I can't throw it away. It could still be useful. I know I'll use it some day. I don't know when or where. But I *know* that I will find an urgent use for it when the time comes.

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One *never* throws away good cultch. Saving cultch is what shoe boxes and cigar boxes were made for. The only reason I buy a new pair of shoes is to get a new shoe box in which to store a growing hoard of cultch. I gave up smoking many years ago and cigar boxes are hard to come by. But I manage to get my hot little hands on enough of them to maintain some semblance of order in the Nitrosyncretic Laboratory.

An aircraft mechanic always keeps a collection of cultch. However, he calls it his "hell box." I think every mechanical and technical specialty has its own specialized word for cultch and the container(s) in which cultch is kept.

Cultch is an integral part of technology. It's something that's never taught to you in engineering school. It's something you learn about the hard way out in the real world where you *have* to make the technology work.

Cleaning out the shop so I can continue to work in it is traumatic. I'm forced to make life-and-death decisions concerning what is junk and what is cultch.

What can I throw out?

What *must* I save?

So you think it's easy? When I moved from Connecticut to Arizona in 1973, I made the horrible mistake of *giving away* my cultch collection to a friend. I was paying the moving expenses myself, you see. As I was becoming established in our new home and trying to get all the diddly little things working—the sort of stuff the real estate agent conveniently forgot to tell me about—I discovered that I did not have that brass part for the lighting fixture I'd put away a decade before.

You know how parts for lighting fixtures are. And a lot of other things, too. The manufacturer makes a production run, then he throws away the tooling and all the leftover parts. Four years later, try to match the artsy metal shade that got bent when the cat knocked it over! Try to find the oddly-shaped pot-metal cap with the strange left-handed interrupted Mongolian screw-thread!

Or somewhere in the intervening quarter of a century, some bright techies or brilliant marketing people got together and *changed the standards!* So no one makes it any longer. Solid-state electronics is like this. Want to know why nearly everyone throws away an old solid-state electronics unit these days? Where the hell can you find a 2N107 transistor today? Answer: My cultch box labeled "XISTRS" which sits on the shelf next to another box labelled "YR." (An inveterate cultch collector develops a personalized patois and labeling nomenclature. I don't care if you can't understand it. I can, and that's what counts.)

It took nearly a decade to build my cultch pile to a state where I felt comfortable with it. Now I believe I'm capable of making or fixing nearly anything again. Provided I've got enough time to do it. And provided the spirit moves me, of course.

And provided I have the proper tool. Right?

I have managed to get this aspect of my life under control. I no longer feel a compulsive urge to walk out of a hardware store with another tool.

I am a tool junkie. I am now able to admit this to others.

After all, what is one factor that sepa-

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rates a human being from lower animals? A human being is a tool user, right? And if you don't have the proper tool, the job is going to take forever. Maybe it won't even get done properly. Or it will be extremely difficult.

Most mechanics and technicians are also tool junkies. If this was not a fact of life and a constant of the Universe, why do tool manufacturers have vans—mobile stores—stuffed full of tools manned by a driver who makes regular calls at all garages, airplane hangars, and other locations where fellow tool junkies work?

One wall of the Nitrosyncretic Laboratory is covered with a peg board on which hangs a plethora of tools. Two mechanic's tool chests contain other tools which are too small or too difficult to hang on the hooks. Three more tool boxes contain 70 pounds of tools that are required to work on automobiles or airplanes.

Maybe one reason that I have been able to get my tool compulsion under control is the fact there aren't very many new tools that are left for me to buy.

Several years ago, I discovered how many tools I really had and what they were worth. I suffered one of the worst fates that can ever befall a tool junkie: Someone stole a 40-pound box full of tools that I had inadvertently left in my unlocked garage. I hope whoever took it got a hernia trying to lift it.

I *knew* what I had in that missing tool box just like my wife *knows* exactly what she has in her sewing box. Screwdrivers. Open end box wrenches. Torque wrenches. Speed wrenches. Files. Sockets. The list was three pages long. It took several thousand dollars(!) and more than six months before I replaced everything that had been in that box. But I could never replace the cultch that I kept in there—plastic film canisters full of nuts, bolts, screws, washers, clips, rivets, electrical connectors, and other necessary pieces that are required to keep technology working.

My son is also a tool junkie, and he's a pretty good technologist as well. I feel good about this. I came from a home where we had one hammer, a bent screwdriver, a pair of slip-joint pliers, and a flashlight. Sometimes the flashlight worked. These items were kept in a kitchen drawer surrounded by hundreds of cooking tools—knives, ladles, spoons, spatulas, and even an egg coddler. Of course, back in the Olden Days, there wasn't as much technology around that needed fixing. Life was simpler. Technology was simpler. We had indoor plumbing that used galvanized cast-iron pipes that were screwed together. We had electricity in the form of a single-phase 50-amp utility drop to run 60-watt incandescent light bulbs, the refrigerator, and the single AM radio in its huge mahogany cabinet. Our cars looked like big boxes on wheels and were powered by huge, low-compression, long-stroke engines that ran on 50-octane white (unleaded) gasoline and could be fixed with that screwdriver and pair of pliers.

I wouldn't go back for anything!

I am a cultch collector.

I am a tool junkie.

I *like* modern technology and look forward to more of it.

It keeps me sane in a world where I often wonder if I've fallen down the rabbit hole again.

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It helps me face reality because if I don't fix the device right, it could kill me.

Technology is more than books, know-how, catalogs, and specialty stores full of goodies. Technology is a well-equipped shop. Technology is a matter of junk, cultch, and tools. Without those three things, technology is academic. And we'd be sitting around on the cave floor fighting over scraps of raw mammoth meat. ■

IN TIMES TO COME

● You may have noticed the slightly different logo (and title) on this issue of *Analog Science Fiction & Fact.* Don't be alarmed: we're making this change solely to make the logo easier to read, and the nature of the magazine more obvious to the newsstand browser. Inside, we'll still be bringing you the same smorgasbord of science fiction and fact you've come to expect every four weeks.

Nicholas Jainschigg's cover for our December issue shows a key scene from Laura J. Mixon's two-part serial, *Glass Houses.* What prognosticators often forget is that no single trend proceeds in isolation. Suppose, for example, that we *are* entering a period of dramatically increased atmospheric greenhouse effect. How might we adapt? Well, suppose also that concurrently the tools for telepresence become widely—but not universally—available. *Glass Houses* vividly and engagingly portrays a kind of future that might result—and a woman who learns to make the best of it.

Coincidentally, John Gribbin's fact article ponders the question, "Whatever Happened to the Little Ice Age?" The rest of the fiction line-up is full of variety, including life on a world whose orbit is best described by chaos theory, and a couple of things that might be construed as seasonal. We realize that neither Hallowe'en nor Election Day really comes in December, but then neither does your December issue. So it seemed as good a time as any to offer you one story appropriate to each!

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THE GREENHOUSE PAPERS

Jeff Hecht

Beware of joking with bureaucrats. . . .

"What puzzles me," said Alice as she picked at her salad, "is where the extra carbon goes. The carbon dioxide budget must have been balanced before people messed it up. Clearing forests, burning fossil fuels, and other human activities add carbon dioxide to the atmosphere. But your model adds a lot more carbon dioxide than the measured increase."

I nodded glumly as I chewed my alfalfa sprouts. My global carbon-cycle project was not going well. The computer model was supposed to be my stepping stone from a postdoc to a permanent job. Yet even the university's most powerful Cray couldn't make the numbers add up. "At least it isn't removing carbon dioxide from the atmosphere," I reminded her.

"Your last run made carbon dioxide increase almost twice as fast as the real measurements," Alice grumbled. "I know there are uncertainties, but they aren't that big. If your numbers were real, the greenhouse effect would be cooking us already."

"Did I hear you talking about the greenhouse effect?" Professor Andrew Harrison Harding settled his 250 pounds of immaculately groomed and impeccably tailored bulk into an empty chair. His tray was laden with the faculty club's most fattening specials, rare roast beef, baked potato, and blueberry cheesecake.

"Yes we were, Andrew," Alice sighed. "I suppose you're going to tell us that your economic voodoo rites can make it go away."

"Now, now, Miss Morris," he returned in his most condescending tone. Alice was a full professor with a named chair, at least ten years older than the economist, but he never used any of her proper titles. "I would certainly hesitate to put economic science in the same cat-

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egory with weather forecasting. After all, we do rely on fundamental principles and laws."

Alice arched her eyebrows, holding her response until she finished chewing a slice of cucumber. "I suppose you do. Weather forecasters have to say which way the wind blows, but you only see it blowing to the right."

"I suppose you claim to be objective?" he harrumphed. "The greenhouse effect is just the latest leftist cult in the physical sciences. You recall the energy crisis, perhaps? Or limits to growth? All futile efforts to find ways to stop the continual expansion possible with supply-side economics."

"The buildup of atmospheric carbon dioxide is proven by carefully controlled measurements. The association of warmer global temperatures with increasing carbon dioxide is good enough to pass tests of statistical significance. Measurements of air preserved in the pores of glacial ice show that carbon dioxide levels rose at the end of the Ice Age. Would you like the references, Andrew? Or would they go beyond your ability to manipulate numbers to your advantage?"

He looked up from his plate. "My dear Miss Morris, I think you malign me. I distinctly overheard you say that you couldn't explain where all the carbon went."

"So what does economics have to do with that?"

"Perhaps that excess carbon is going into consumer goods, produced by the workings of the new economics. Plastics, certainly," he paused to look at his fork, but it was metal. "Housing, furniture, clothing, and even paper contain carbon." He brought the fork the rest of the way to his mouth.

"Do you know how much excess carbon is involved, Andrew? Five billion metric tons a year. That's more than the amount of hot air generated by all the world's economists and politicians."

I had work to do and no patience for endless arguments. Alice's politics dated from grad school at Berkeley in the sixties; she secretly hoped the greenhouse effect would melt the ice caps, flood Wall Street, and drown the bloated capitalist swine. Andrew Harrison Harding was one of the new conservatives, getting rich with lucrative consulting contracts. I caught Alice's eye and excused myself.

When I arrived at Alice's office later in the afternoon, I made the mistake of asking if Harding might have said something worthwhile.

"That fool makes me respect the academic credentials of the physical education department!"

"But shouldn't we consider human possessions in our carbon balance sheet? A wooden house must contain a few tons of carbon, and it stays there forever, or at least until it's replaced by a new house. Say four people per house, add the furniture, and . . . "

She shook her head. "It won't balance the books, Petra, even with Andrew's crooked numerology. People don't build houses every year, and they aren't all made of wood, anyway. There's probably some effect, if you multiply the rate of population increase by carbon per household. But most of it is in developing countries. They certainly aren't accumulating much

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wealth. You can add it to the model, but it's not going to solve anything."

She was right, of course. I slumped discouraged in the chair, dwarfed by the stacks of journals on her work table. "What can we do to balance the equations?" I asked. "We must be missing SOME carbon sinks."

Alice nodded. "It's all very hard to quantify, and it's even more complex because it might change with time, if the carbon sinks get saturated. Some new work claims the major sinks are on land in the northern hemisphere, and nobody knows how effectively sea water soaks up carbon dioxide or where it goes from the ocean surface." She sighed in discouragement.

An undergraduate knocked at the door, a typically tall and skinny kid with rumpled kinky hair. "Professor Morris?" he asked, hesitatingly. "I had some questions about this assignment. . . ."

It was time for Alice's undergraduate office hours. I excused myself to look for some fresh ideas. They were very slow in coming.

Over the next week, I added the carbon content of housing to the model, and it vanished into insignificance. I adjusted some assumptions about the atmosphere, with no visible result. Two days of searching every database vaguely related to carbon-dioxide absorption by the oceans gave me sore eyes, and left me amazed at how little solid information existed.

I was comparing two runs of the model when Alice arrived at my tiny basement office bearing her briefcase and a grim expression. "Did you keep track of how many runs you made last month, Petra?"

I shook my head, beginning to feel uneasy.

She pulled a green-and-white printout from the briefcase. "I just got our statement from the computer center. Your model has eaten my entire Cray budget, and there's four months left in the fiscal year."

"So no more Cray?"

She nodded. "At least until you take on some of the fund-raising burden." She dropped a fat manila envelope onto my desk. It was standard government issue, with a stylized black eagle printed in the upper right corner. Her expression told me to open it.

The form letter seemed to bear good news. "The Agency will entertain innovative conceptual proposals with objectives which bear relevance to alleviating the release of greenhouse gases into the atmospheric environment." A quick scan of the photocopied polysyllables revealed no specific goals, but plenty of buzzwords: "innovative," "fundamental concepts," "high leverage," "potential" and "breakthrough."

I looked up at Alice. "It sounds like they want lots of blue sky with less carbon dioxide. You want me to write something?"

"You want any more computer time?"

I sighed and looked back at the cover letter. My eyes opened wide when they caught the name at the bottom. "Andrew Harrison Harding, special consultant to the Administrator!" I read in disbelief.

"Oh, it's *that* project," groaned Alice. "I heard about it. Andy knows the

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administrator, and he pulled strings to sneak some money to needy economists. Don't bother with it," she said. "I'll see if I can scare up something to get us some money. Meanwhile, stay off the Cray."

I stopped by Alice's office early the next morning, looking for something to do until I could get back to the computer model. She invited me in, apologizing as she removed a pile of journals that had slipped into the last empty chair. "I'm afraid I can't keep up with these journals. Sometimes I think they just grow here."

Inspiration struck as I glanced around the cluttered office. Floor to ceiling bookcases packed with journals lined one wall. Another big bookcase stood beside the window, and two more along the same wall as her desk. All that paper was the product of years of research on the greenhouse effect. "Paper," I said, as the light dawned, "the magic word is paper."

She looked at me, completely baffled, not at all the usual self-possessed Alice.

"Paper," I repeated, looking at the crammed bookcases and overflowing table. Alice had stocked her office with the better part of a forest. "How much paper do you have in this office?"

"I don't know," she replied distantly. "A lot, but it contains a lot of—"

"You've saved tons of paper. As long as you keep it, the carbon in it will never become greenhouse carbon dioxide. That's what's helping the continents soak up carbon."

"Oh, Petra!" she sighed, "don't be ridiculous. Why don't you settle down and think up a proposal to get some money for computer time? Do you want to be a postdoc forever?"

I trudged dejectedly back to my cubicle, in no mood to accomplish anything. Andrew Harrison Harding's request for proposals still sat on the desk. I picked it up, wondering how much paper had been wasted on it. Could accumulating paper really slow the greenhouse effect? With nothing better to do, I decided to quantify the matter.

The first task was to estimate the carbon content of a typical 8.5 by 11 inch page. Precision demanded careful carbonization of several hundred representative sheets, weighing the ashes on analytical balances, averaging the results, and taking means and standard deviations. I took a ream of paper from the storeroom, weighed it on the department mail scale, divided, guessed at the carbon content, and got a rough estimate: one gram of carbon per sheet.

The next step was converting five billion tons of carbon into paper units. The result was on the back of an envelope in a second: 5×10^{15} sheets in proper scientific notation, or five quadrillion if I really wanted to impress someone. Divided by world population, it was a million sheets per person. That—I found by measuring a box of computer paper in the storeroom—is a pile about 100 meters high, or a volume of 6 cubic meters. Three solid closets a year! Even Alice did not collect that much.

What about junk mail and other solid waste? Trash in landfills doesn't decay very fast, so I could assume it stays there almost forever. One reference said each American generates about 750 ki-

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lograms of solid waste a year. If 100 kilograms was carbon sequestered in landfills, and if everyone in the world generated that much solid waste, that would only account for half a billion tons of carbon. However, most people live in developing countries where they don't generate as much trash.

I should have stopped there. I would have stopped, if I had had anything else to do. But I didn't, so I browsed through the library, getting more and more frustrated with the carbon-dioxide problem. The literature contained perfectly serious proposals to plant an area the size of Australia in fast-growing trees, cut them down every few years, and bury the wood so it would not decay. Nobody was doing anything about the greenhouse effect but generating hot air and paper.

The least I could do, I decided on the way back to my basement office, was to show how ludicrous the whole thing was. Sitting at my desk, I devised a purely paper solution. To generate the needed paper, I would put scientists to work generating reports. The greenhouse is an important global problem, so everyone in the world should get the reports, and preserve them indefinitely. It would take 10,000 scientists, each writing a 100-page report each year, to generate the required million sheets of paper per person.

I would be lucky to wind up as one of them, I thought sourly, then saw Andrew Harrison Harding's request for proposals sitting in my basket. "Why not?" I asked myself, and switched on my word processor, convinced I could do better than any economist.

The words flowed freely all afternoon. At least, I told myself, I was practicing the proposal-writing skills that Alice thought were important. Gloss over difficulties, she had advised in a cynical mood. Waving my hands, I dismissed the energy costs of producing paper as "an issue to be studied in more detail in a separate study, but obviously of an order of magnitude no more than comparable to the energy costs of burying biomass to sequester carbon." I passed off the request for a preliminary environmental impact statement by saying that paper producers would be required to abide by existing laws.

I broke for a light dinner at the university cafeteria, and returned with the best idea of the day. In the section on "Long-term impact" I explained how paper reserves could provide a feedback mechanism to prevent a return of the ice ages. "Ice core measurements show that past declines in atmospheric carbon dioxide were associated with cooler temperatures and glacial episodes," I wrote. "In the event that too much carbon is removed from the atmosphere, the paper reserves could be burned, depositing extra carbon dioxide in the atmosphere to restore the proper greenhouse balance, and providing short-term heat to people in the bargain."

By midnight, the whole crazy thing was finished. I printed it out, bundled it with the request for proposals, and left it sitting on Alice's desk for her perusal in the morning.

What I had not counted on was Alice coming down with the flu. She didn't show up Friday, and it was my turn the following Monday. Tuesday and Wednesday she was out of town at a seminar, and by Thursday I had gotten

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involved with another postdoc's simulations of atmospheric methane flux. It was not until the following week that I asked Alice what she had thought of my mock proposal.

"What?" She had never seen it, and a careful exploration of the desktop debris revealed no sign of it.

"I'm sure I put it right here," I said, pointing at a basket on her desk.

"Are you sure it was that basket?" A troubled expression came over Alice's face.

I nodded. "It was the only one I could see."

"That's the OUT basket. I think it lost its label. IN is over here," she pointed to a second basket hidden by a foot of papers. "Things left in the OUT basket are mailed."

As my stomach sank, I asked what might happen.

"Knowing how the wheels of bureaucracy grind, with any luck we'll never hear of it again."

Somehow I was not reassured.

It was several weeks before Andrew Harrison Harding again settled his pinstriped bulk at our table with a tray overflowing with lunch. He was all smiles.

"My dear Petra," he began. "I was so pleased to see your proposal. The reviewers gave it the highest rating of any that we saw."

I stuttered an expression of gratitude as Alice's jaw dropped in astonishment. I kept cool. Crazy idea or not, this could be my ticket to a permanent job.

"We're going to give you the full half million, of course," he continued. "But we did have one long-term suggestion. It's our deep belief that the best solutions to any problem—indeed the only possible solutions—come from the private sector. That's why we have no faith in planting trees or trying to be more energy efficient. There's no profit in it. But your proposal nicely complements one of my own ideas, which is to draw on the expertise of the magazine and advertising industries. We can minimize public-sector expense and demonstrate once again that the private sector can provide the proper economic solutions."

I didn't dare look at Alice. It was all I could do to keep my own composure.

"The optimum solution," he continued, "is publication by the private sector. It should be easy to demonstrate potential profits. Look at the success of trade magazines, and free weekly papers mailed to residents of suburban communities. These publications will go to everyone on the planet, for a guaranteed circulation of five billion. They have a long-term captive audience, moreover, because everyone will have to keep them. We can have different demographic editions, and companies can use their advertising to show their concern with bettering the planet. In fact, I am proposing an economic assessment to show the idea is impossible for advertisers to resist."

Steam was rising from Alice's ears. "Andrew," she sputtered, "this is the most. . . ."

Knowing what was coming, I kicked her firmly under the table. Speechless, she looked at me in bewilderment and dismay. This might be the most insane geophysical project in recorded history. But if they wanted to give me all that money, the least I could do was take it with a straight face. ■

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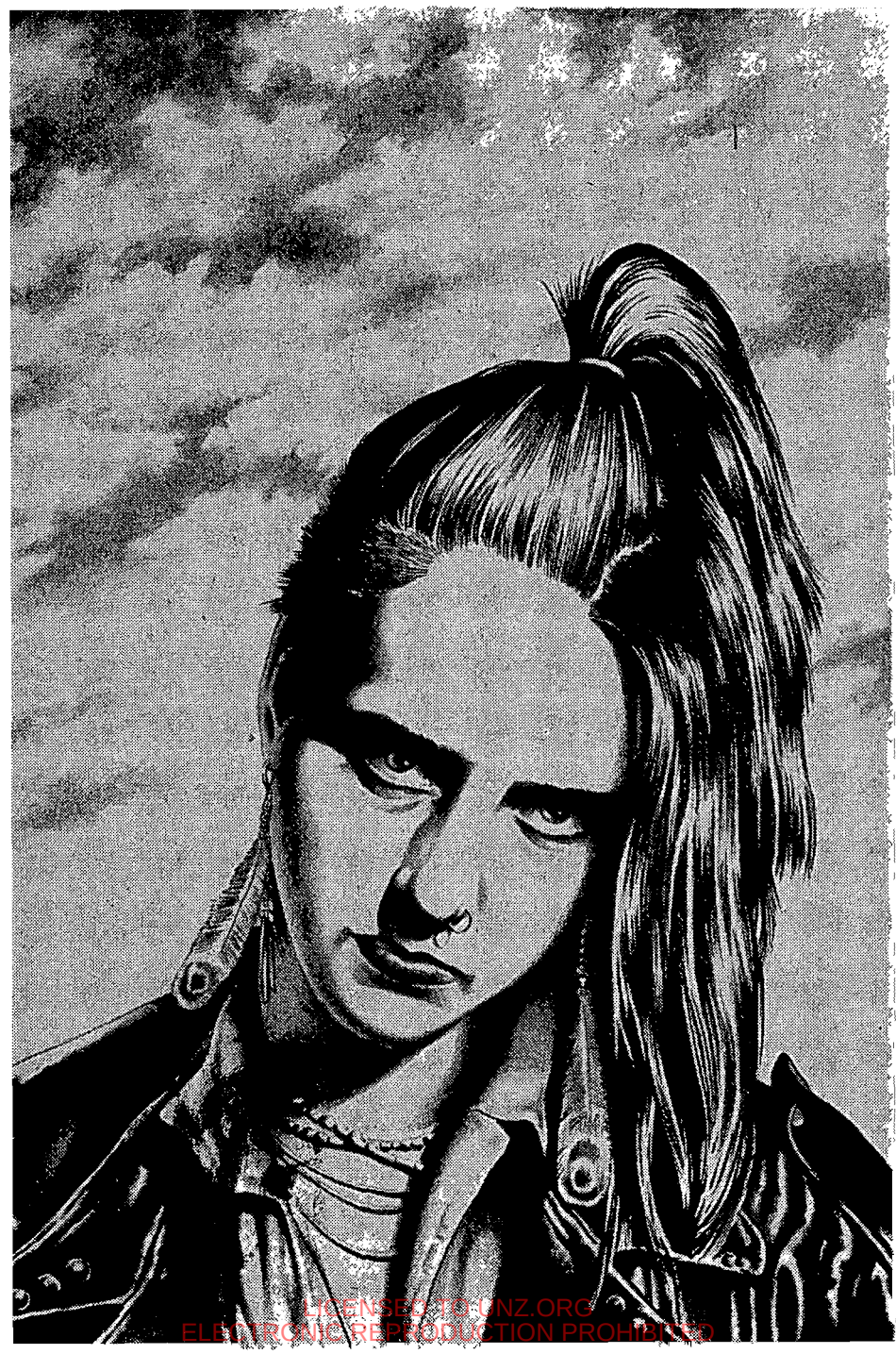

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HOME IS WHERE . . .

Maya Kaathryn Bohnhoff

Or, when "when in Rome . . ." wears thin. . . .

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Anastasia Jones viewed her new town with little interest from the crest of a maple-shaded hill. It was a fresh-washed picture postcard of a town; all green and white and brick-red under a rain-dark sky. An equally fresh-washed breeze rolled up the hill, carrying with it the smell of . . . popcorn.

Anastasia smiled. Now *that* was interesting. She scanned the buildings along the cobbled main street. Ah, yes, there it was—a theater. She could see the ornate marquee peeking up at her between elm sentinels.

"Looks like they've picked another homespun backwater," said a voice over her shoulder.

She turned, noting that her brother's face looked just as dour as it had the last time she'd seen it. "What'd you expect?" she asked. "They do this every time we start whining."

"I don't whine, Stasi."

"No, you pout. The twins whine. I sulk." She swept moist strands of deep burgundy hair from her forehead with one hand and brushed her wind-climbing skirts down with the other. Her eyes searched the trees. "There's the school," she said finally, and pointed.

"Oh, royal. Another one-roomer?"

"No. . . . It looks kind of nice. All brick and white-washed and a green roof."

"Don't get too attached to that green roof, sis. We won't be here that long."

"I wish—"

"If wishes were wheels, gramma would've been a trolley car."

Anastasia giggled. "Where'd you dig *that* up?"

He shrugged. "I dunno. Somewhere about three stops ago."

"What does it mean?"

"Who knows. Does it matter?"

"Anastasia! Tamujin! Dinner!"

Tamujin Jones made a goofy face. "Sounds real down home, don't she?"

His sister giggled again. "Well, at least she didn't ring that stupid triangle she got in Armadillo or wherever that was."

"Amarillo." Tamujin snorted. "Armadillo! Geezumminy, Stasi, no wonder you're having so much trouble with geography. You've gotten it mixed up with zoology!"

The new school was OK, Anastasia decided. It was old and neat and smelled of ancient wood varnish, fresh wood oil, and cedar. Their parents had done the obligatory first-day-in-a-new-school thing and delivered them to the Admin office all smiles and pride. They'd filled out the paperwork, kissed their children, and gone off for a day of getting-to-know Papillion.

"Have fun," they'd said, but their parting message, as ever was, "*Do* try to fit in."

So much for fun.

Now they sat on a wooden bench in the Admin office waiting for the vice-principal, Mrs. Thorpe, to escort them to their classes. She arrived in due process, wreathed in smiles, flourishing four fresh, new file folders. A pair of spectacles dangled from a cord around her neck.

The twins stared at her, making Anastasia wish she could reach across Tam's lap and pinch them.

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"Well!" The apple-cheeked face beamed freshness at them. She even *smelled* like apples. "What a *lovely* family! Your parents are such *lucky* people. So . . . " She set the spectacles on her nose and flipped open the top file folder. "Your names are . . . very unusual. Anastasia?" Her eyes bounced kinetically back and forth between the two girls.

"That's me," said Stasi. "Please, call me Stasi."

"Oh." She pulled a pencil from behind one ear (the twins fairly ogled) and made a note, then went on to the next folder. "Tamu-?"

"Tamujin," he said. "I go by Tam."

"That *is* unusual. What nationality is that?"

"Mongolian."

"It's Genghis Kahn's first name," offered the staring, blonde gamine next to him.

"Oh, my! How did they ever settle on that?"

Tam turned beet-red and threw his little sister a get-even glance. "Dad's a . . . a historian. He's fascinated with that period."

"I see . . . well . . . " She made a note, then glanced at the twins. "Now you'd be Constantine, I'll bet.

"Connie," said Tam.

"Con," said Constantine. "Connie is a girl's name, here."

"And Tahireh . . . my, that's pretty."

"It's Persian," explained Tahireh proudly, then announced, "Tahireh was a martyr in the cause of women's suffrage."

Mrs. Thorpe's face froze, whether because the vocabulary was a bit precocious for an eight-year-old or because either martyrdom or suffrage was an unusual topic of conversation for a child that age, Stasi couldn't guess. Mrs. Thorpe wriggled her lips back into a smile. "Really? How interesting."

"They strangled her with her wedding scarf and threw her body down a well. Just before she died she said, 'You can kill me as soon as you like, but you cannot stop the emancipation of women.' "

Mrs. Thorpe let out a nervous giggle. "How precocious!" she burbled, then whisked them away to their classes.

Stasi thought she'd like her teacher. Her name was Mildred Tindall and she was young, pretty, and quick to praise. She exclaimed over what a pretty name Anastasia was and said she thought Stasi's dress was strikingly beautiful and that she liked the unusual color of her hair.

Stasi was not so sure she was going to like her classmates. She overheard one of them say her dress was "antique" and her hair was "weird" and her name was "foreign."

This is a learning experience, she told herself and ignored the whispers and the fact that she really did look dreadfully out of place among these wearers of plaid and poodle skirts, saddle shoes, and natural-colored pony tails.

By lunch time she had acquired a reputation as a Brain and heard the words "teacher's pet" whiffle softly through the air over her head. She thought briefly about playing dumb, but Dad said never to stifle your natural abilities to suit anyone else's expectations and besides, it rubbed her the wrong way.

She was on her way to the cafeteria when she felt someone lift her ankle-

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length skirt from behind. She skittered sideways, nearly colliding with a group of loitering boys and turned to find herself confronting three of her female classmates. They peered at her archly, their notebooks clasped to their chests like battle shields.

"Why do you wear such weird clothes?" asked one of them. "Beth says it's because you're a Quaker or something. Are you a Qu-a-k-ker?" Her voice wavered and cracked on the last word and the two girls flanking her giggled.

"No. I'm a Bahá'í," Stasi told them.

"What's that?"

"It's a religion. Excuse me. I'm going to be late for lunch."

She started to turn away, but the tallest of the three moved to cut off her path of retreat.

"So why *do* you wear such weird clothes?"

Stasi muzzled her considerable temper and said, "I just haven't had a chance to get any new clothes since we got here. This was the height of fashion the last place we lived."

"Oh, yeah? And where was that, Mars?"

Stasi drew herself to her full height. "Paris, actually. France."

The girls exchanged glances. "Prove it," said the first one, truculently. "Speak some French, if you *can*."

"Mais, bien sûr. Je pense que vous parlez très follement. Maintenant, excusez-moi. J'ai faim." And she slipped quickly away.

"What'd she say? What did you say?" They were on her heels.

"I said, 'I'm hungry.' "

"All that, just to say you're *hungry*?"

She kept moving.

"You didn't really speak French! You just made that up!"

"I'll bet you got in trouble for doing that to your hair!"

She escaped into the cafeteria.

She was standing in the chow line craning her neck to see where Tam and the twins might be when she felt someone jiggle her elbow. *Oh, God, Please!* she thought. *Not again.* She turned to find a pair of pale, spectacled eyes peering owlishly at her from beneath a fringe of overly curly dishwater-blonde hair.

"Hi, I'm Elaine. I sat behind you in class today."

"Oh, yeah. Hi."

"You just have to ignore them, you know." She tilted her head toward where Stasi's tormentors flirted with some male students. "They really *do* say the silliest things. I like your hair," she added, eyeing the deep red bob. "It's different."

"Thanks." Anastasia managed to turn her ogle into a shy smile. "Would you like to eat lunch with us? My brothers and little sister should be around somewhere."

The smile bounced back from Elaine's silver-clad teeth with increased amplitude and Stasi felt a sharp twinge of precognitive agony. For any member of the Jones family, a friend gained was a friend lost.

After suffering Tam's disapproving glances, Constantine's moping and Tahireh's constant chatter on the shuffle home, Anastasia was ready to explode. Her mother's half-cheery, half-anxious,

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"Well, how was the first day?" was like a match to a short fuse.

"Oh, Mom, it was *awful!* They teased me about my name, my clothes, my hair . . . *everything!* Mom, when can I get some new clothes?"

Helen Jones went for the obvious out like a hunted vixen through a privet hedge. "Why, sweetie, all you had to do was *ask*. How's tomorrow after school?"

Stasi rolled her eyes. "I could swoon with relief!"

"It's a date. Maybe you should wear something a little less . . . conspicuous tomorrow. OK?"

"No problem. I'll go see what I can dig out." Stasi disappeared up the stairs.

Helen Jones scanned her remaining children's faces warily. "So, how about the rest of you?"

"It was terrible," grumbled Constantine. "Everybody called me 'Smarty-pants.' Nobody would play with me at recess because they thought I was showing off for the teacher."

"Were you showing off for the teacher?"

"Mo-om! All I did was add a column of figures."

"Six digit figures," inserted Tahireh. "In his head."

"Well, what'm I s'posed to do—play dumb?"

Helen grimaced slightly. "Of course, you shouldn't play dumb, but you could pretend to be working it out on the blackboard."

Con glowered and stuffed small fists into his pockets. "I s'pose."

Helen glanced at Tahireh, who announced unprompted, "*I* had fun. I told the whole class about my namesake. They thought it was *so* dramatic. I'm going to like it here." And she took herself off to the backyard. Con followed like a moping shadow.

"Well?" Helen swung away from her roll-top desk and regarded her remaining child with some trepidation. He still hung back in the archway between the entry hall and the parlor, looking sullen and rebellious. "What happened to you?"

"Nothing," he said dully, and turned to head for the stairs. He paused in mid-turn and looked back over his shoulder. "Stasi made a friend today." His eyes accused her.

She smiled weakly. "That's nice."

"No, Mom, it's not nice. She does this every time. I've learned not to, but she just keeps doing it."

"Then, she obviously needs to do it. She's fifteen. That's a critical time for friends."

"Oh? Well, how long are we going to be here then, Mom? Is Stasi going to graduate from this school with her friends? Am I?"

His mother's smile strained at the eyes and slipped at the corners of her mouth. "I don't know, dear. It depends."

"On what, Mom? On what, this time?"

"The book your father is researching—"

"The Book. The Project. The Grand Theory. The Curiosity. Jesus, Mom, are we ever going to have a real home with real friends that we can invite into the house?"

Helen's expression changed radically from Mom-on-the-run to Mom re-

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proachful. "We do not use that name as an expletive, Tamujin Jones. And this *is* a real home. Home isn't a place, you know. It's people. Family."

"Yeah, I know. But sometimes family's not enough. Sometimes we need friends, too. You and Dad get so caught up in your work sometimes."

"I know. I know. But why can't you make *real* friends here?"

"C'mon, Mom. You know why."

"Lots of people move around—military personnel, field scientists like your father and I—"

"But they can at least *write* to the friends they leave behind. *Call* them. *Visit* them. We can't do any of those things, Mom. We just keep leaving little bits of ourselves all over the place while we get smaller and smaller."

He turned away from her then, and bounded up the stairs. She sat for a moment, thinking, then dropped her notes into the drawer of her desk, shutting and locking it. Then, she went to call her husband.

They were halfway through a semi-glum dinner, when the elder Joneses started glancing at each other the way parents do when they've been plotting behind their children's backs. After several minutes of this, Troy Jones made an announcement.

"Mom and I have been talking," he said, and Anastasia tried not to recall the last announcement that had been so prefaced.

"Congratulations," returned Tam, and asked for the mashed potatoes.

His father ignored him. "We realize our existence is rather . . . Bohemian."

"Is that what it is?" mumbled Tam.

"We know you get a little lonely and sometimes feel a bit out of place."

"Try all the time," said Tam.

His mother interceded. "Tamujin, quit behaving like a verbal sniper and let your father finish what he's trying to say."

"Yeah," agreed Tahireh. "This could be good."

Troy Jones bowed his head to his youngest daughter. "Thank you, Tar. Now, what I'm trying to get to is this: We know how hard it is on you to have to keep your friends at arm's length, so we've decided you don't have to do that anymore."

"Excuse me?" said Stasi, not sure she'd heard him right.

Helen smiled at her children brightly. "We've decided you can bring your friends over. Isn't that great?"

Four pairs of young eyes stared at her.

"Seriously, Mom?" asked Stasi.

"Seriously."

"Magnifique!" exclaimed Tahireh.

"Of course," her father cautioned, "there will have to be some new house rules to accommodate this. We can't have people wandering into restricted areas, and we can't mark them as restricted areas without arousing too much curiosity. So, we'll have to disguise those areas. You'll also have to be careful with your personal belongings. OK? You won't be able to leave stuff out where your friends can stumble over it."

Constantine's nose wrinkled in consternation. "You mean we have to put *all* our stuff away?"

"That would be best."

"But if we don't have toys or any-

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thing our friends will think we're fanatics. You know what the Book says about fanaticism."

Troy Jones spent a solid five seconds looking completely confounded. He knew very well what the Book said about fanaticism and was trying to work out how he could not have it apply to this situation.

"It's OK, Dad," Tam interjected. "Stasi and I will go through their stuff and pick out what's OK for public consumption."

Troy smiled. "Thanks. Now, you can't all bring friends home at once, so we'll have to set up a system."

"How about first ask, first come?" asked Tahireh.

Her father considered that. "Sounds reasonable."

She immediately raised her hand, waving it energetically in the air over the casserole. "Me! Me! I'm first! Can I bring my new friend, Frog, home for dinner tomorrow?"

"Frog?" echoed Tam. "Is that a friend or a pet?"

"His eyes are kind of buggy," Tahireh explained, "so the other kids call him 'Frog.' Can he come?"

Helen glanced at her husband. "How about Friday? We'll need some time to police the household."

Tahireh nodded. "Friday's good."

Dinner was a little more companionable after that, but Stasi couldn't help wondering if they'd just opened themselves up to a whole new order of agony.

"It's just going to make things worse," said Tam stonily. He kicked at a puffball toadstool and was satisfied when it burst, scattering its powder of spores everywhere.

"Must you abuse the local flora?" asked Tahireh, then charged away from him down the path into town.

"I know," said Stasi. She admired the way the grass along the path lay over in the wind like soft, green seaweed in a lazy current. She leaned over and ran her fingers across the undulating tendrils.

Tam stopped beside her on the trail and watched her. "You're going to make friends with that Elaine, aren't you?"

Stasi straightened. "I suppose so."

"Why? You know what'll happen. It's just going to hurt."

"I know. But I can't shut everybody out the way you can."

"You could learn. I did." He turned and walked on down the path, leaving her alone under the maples.

She felt suddenly morose, and followed him lethargically to school where everybody she saw stared at her. *Really* stared, as if she was still wearing her pajamas. It was even worse than the day before. She glanced down at herself. Her jeans were zipped, her shoes were tied. She tilted a glance over her shoulder and down her back. There were no rips, no stains, no signs that said, "Kick me!"

It must be my earrings, she thought and settled at a desk next to Elaine in the second row.

Everything seemed normal after that until Miss Tindall asked a question and Stasi rose to answer it. She'd barely gotten two words out of her mouth before she became aware of a sudden shift in the level of tension in the room. She

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heard a gasp, a murmured "uh-oh," and glanced down at Elaine, who was staring at her incredulously.

Miss Tindall, hearing the sudden silence behind her, turned from the blackboard. "Now, I know—" The class was never to hear what she knew. Her eyes widened. Her next utterance was, "Stasi—!"

Anastasia blinked and stared back into her teacher's face. Had the world chosen this morning to go completely mad? She suddenly felt like Alice facing a pack of ogling playing cards and the Red Queen.

Miss Tindall set her chalk in the tray and dusted her fingers on the neat piece of gingham flannel she kept on a hook by the board. "Anastasia," she said, "please go out into the hall and wait for me."

"Why? What's wrong?" She heard "What's wrong?" echoed derisively by several muffled voices.

"In the hall, please. Class, you may start your reading assignment on page five in the history text while I'm gone."

Stasi let the door fall shut and waited, miserably, in the silent hallway. What was wrong with her? Had she suddenly sprouted a moustache and glasses? She explored her face gingerly. Did she have spots? She was supposed to be inoculated against just about every known disease. Had one of her siblings played a joke on her?

The classroom door swung open and Miss Tindall appeared, looking very serious. "Anastasia, can you explain yourself?"

No, Miss Tindall, I can't, she thought. Aloud, she said, "Explain what? What've I done? Why is everyone *staring* at me?"

"Are you serious? Young lady, what do you expect, when you come to school dressed in such completely inappropriate attire?"

Stasi did a quick mental inventory of her person. The simple white shirt, canvas shoes. Her hand flew to the huge black and white zebra earrings that dangled from her ears. "I'm sorry. Is there some rule about earrings?"

"Earrings? Young lady, you are stretching both my credulity and my patience. What ever possessed you to think you could get away with wearing *pants* to school? *Blue jeans*, no less!"

Completely taken aback, Stasi answered honestly. "They made fun of my good clothes. Mom told me to wear these until we could go shopping for something that would . . . fit in better."

"Your *mother* told you to wear blue jeans? I find that difficult to believe. Anastasia, are you sure you're telling me the truth? I don't know of a single school in this country that will tolerate girls wearing pants to class."

"Oh. I'm sure Mom didn't realize that. The last place we lived, you could wear just about anything you wanted."

Miss Tindall looked entirely skeptical. "Oh? And where was this—Mars?"

Stasi blinked and licked her lips, feeling a giggle forming in her throat. "Paris," she said. "Paris, France."

Miss Tindall sighed. "I see. Well, I'm sorry, Stasi, but I really have no choice but to send you home for the rest of the day. When you come in tomorrow, make sure you're wearing a dress. I'll send your assignments home with

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your brother. And I'm afraid I'm going to have to have a word with your mother about this. It's school policy."

"Good," Stasi murmured.

"What?"

"I said, 'Good,' " she repeated, her eyes feeling tight with tears. "Maybe then they'll see that we don't belong here." She darted away, then, down the corridor, out the back door of the Secondary wing and home.

Helen Jones heard the slam of the front door and the rapid pounding of feet up the stairs to the second floor. She left her husband, who was oblivious to both the pounding and his wife's departure from their shared laboratory/office, and went upstairs to find her daughter flung across her bed glaring at the ceiling.

"Well, young lady, can you tell me what you're doing home at 0900 hours?"

"I was inappropriately attired. And if one more person calls me 'young lady' in that tone of voice, I'll scream bloody murder."

Frowning, Helen moved to sit on the edge of the bed. "You were what?"

Stasi sat up and looked her mother in the eye, a mutinous expression on her face. "Girls are not allowed to wear pants to school here, Mom. They think it's immoral or something."

Helen blinked. "Oh. Oh, dear. Honey, I'm sorry. I didn't check. It didn't even *occur* to me that—"

"I know, I know. . . . She wants to talk to you and Dad."

"Who?"

Stasi grimaced. "Miss Tindall. My teacher."

"I'll go in tomorrow morning and talk to her," Helen decided.

"And say what, Mom? What can you tell her that will make her understand why I don't fit in?"

"Don't worry about it, honey. I'll make her understand." She patted her daughter's knee and left.

Already writing the speech, Stasi thought, and flopped back onto the bed with a groan.

They went clothes shopping after lunch, and Stasi spent the remainder of the afternoon wrinkling her nose at her new skirts and dresses as she hung them up and shortening the hemlines of a few of her old ones. That task also required a modicum of facial contortions.

Tam brought her homework in as soon as he got home. She was reading and he dropped the schoolbooks on the foot of her bed.

"What happened?"

Stasi put down her book. "Girls don't wear blue jeans to school in the United States."

Tam whistled. "And Mom and Dad didn't *know* that? Jeez, they must be slipping. They used to have all that suff iced."

"Why should they care? They're too busy researching books and digging up artifacts to care about what's acceptable fashion in some little pie-dink town in Nebraska."

"Podunk," he corrected. "If we were home—"

"Home? What's that?"

Tam stared at the book lying between them, ran his fingers over the smooth plastic covering. That was from Home. "Do you remember Danice Patten?"

Stasi shot him a dark glance. "Of course I remember Danice. She was my best friend."

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"Do you wish we could go back?"

"Stupid question, Tam. What good does it do to wish? What was it you said—if wishes were wheels—"

"What if we did more than wish?"

Stasi looked at her younger brother doubtfully. "Like what? Talking to them doesn't help. They don't listen. You should have heard Mom this morning—all hot-fizz to explain to Miss Tindall why her daughter is such a social misfit. 'I'll *make* her understand, honey,' " she mimicked.

Tam snorted. "That means they're going to do their Richard and Mary Leakey routine."

"Right, and run out that tired old 'Helen of Troy' line. They *love* this, Tam. They're home for each other. They didn't have that many friends when we were Home. Just books and artifacts and colleagues in the field."

"And us. C'mon, Sis, let's not dive off the pier," he added when she pulled a sour face.

"OK. All right. And us. But they never *hear* us, Tam. When we say we're miserable or lonely or homesick, they just tune it out, or pretend we're going through a phase or having a bad day."

"Then maybe we can *do* something to make them tune us in. You know—actions speak louder than words, et cetera."

Stasi picked up the book again, fingering it almost reverently—a memento from another life. Home. Suddenly, she was angry at Tam for even making her think about it.

"What actions, Tam?" she asked, bitter. "What actions could we possibly take that would show them what they can't see? You know what we can do? Nothing. We could all commit suicide tomorrow and they'd think it came out of nowhere."

Tam glanced at her sharply. "You wouldn't—"

"No, of course not. But sometimes I *do* think about mutiny. About tying them up and *making* them take us Home."

"Anastasia!" Their mother's voice floated up the stairs. "Stasi?"

Stasi got up and went out onto the landing. "Yeah, Mom?"

"There's someone down here to see you. Elaine?"

Stasi froze for a moment, suddenly loathe to carry on what she had started. "Um, OK," she said finally. "I'll be right down." She padded downstairs with Tam on her heels and met her Mom and Elaine in the front hall. "Hi, Elaine. What's-what's up?" The last word came out a little too brightly.

"I just wanted to see if you were OK."

"Yeah. I'm all right." She looked at her Mom. "Can Elaine come up to my room?"

Helen smiled, her eyes anxious. "As long as it's clean, dear."

Stasi remembered the book. "Oh, I—"

"It's clean," Tam averred. "Of course, all the embarrassing stuff is under the pillows." He favored his sister with a secret glance.

"Thanks, bro," she told him and led her new friend upstairs.

Troy and Helen Jones appeared in the offices of the Papillion Community School just before classes were to start the morning after Stasi's run-in with

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school regulations. Miss Tindall was obviously surprised to see them —surprised and a little nervous. That they were both dressed in the khaki uniform of field anthropologists might have contributed to that unease. She was determined not to let it show.

"Hello, Miss Tindall, isn't it?" Troy Jones shook her hand. "I'm Troy Jones and this is my wife, Helen."

Helen smiled. "That's me—Helen of Troy."

Miss Tindall smiled in return. "Yes, of course. How amusing." She seated them in a conference cubicle and moved to barricade herself behind a wooden desk. "Frankly, I'm surprised to see you. I didn't expect Anastasia to tell you much about our little misunderstanding."

"Our children tell us everything, Miss Tindall," Troy assured her. "We have a very open relationship."

Miss Tindall looked doubtful. "Did she tell you why I sent her home?"

"Inappropriate dress, wasn't it? You know, I really don't understand that. With the weather being so nippy these days, I'd think blue jeans would be just what the meteorologist ordered."

Miss Tindall blinked. "I . . . there are *rules*, Mr. Jones."

"*Doctor* Jones."

"Excuse me. *Doctor* Jones. There are rules that govern how our young ladies dress. We expect them to be obeyed."

"Why? Good God, surely you don't want your young ladies freezing to death at their bus stops in the winter?"

"Of course not. They're free to wear nice pants *to* school as long as they remove them and put them in their lockers during class."

Dr. Jones ogled. "They run around in their underwear?"

Helen giggled into her hand.

Miss Tindall did not giggle. She didn't even smile. She fixed him with a cool gaze and said, "They wear the pants *under* their skirts, Dr. Jones."

"But that's redundant."

"It's the rule, Doctor. I didn't make the rule. I only enforce it. Do you honestly want your daughter parading around dressed like a boy?"

"Miss Tindall, who defines which clothes are male and which are female? Medieval gentlemen (such as they were) wore leggings *and* skirts. Scotsmen wear kilts to this day. And in Egypt, at this very moment, men stroll the avenues wearing what you would call dresses while their wives do the shopping in what you would call pants."

"This is America, Dr. Jones, not Egypt. And it's 1950, not the Middle Ages."

"Miss Tindall," said Helen quietly, "our children have led a much less sheltered life than their classmates. They've accumulated a vast library of diverse experiences. Anastasia's spent most of her life in jeans and khaki field trousers, digging up history your students here have only read about. It's going to take a while for her to make the adjustment to this more restrictive lifestyle. All we're asking is that you try to understand that what seems bizarre or out of place to you is normal to Stasi."

"Normal," repeated Miss Tindall. "Maroon hair, dresses that look like ankle-length sacks, and earrings made from giant fishing lures?"

"Her hair is burgundy, Miss Tindall," said Helen, "and all of those

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things you just mentioned were quite normal the last place we lived."

Miss Tindall pursed her lips. "Paris, she said."

"Paris," agreed Helen.

"Mrs. Jones—"

"*Doctor* Jones."

"Doctor Jones, I'm aware that Paris is the birthplace of modern fashion, but I find it hard to believe that young ladies there wear such outlandish styles."

"Well, they wore them while we were there."

"I see."

"Do you?" asked Helen. "You see that Stasi is different, but do you see that there's nothing wrong with that?"

Miss Tindall sighed. "Dr. Jones—"

"There *is* nothing wrong with that, Miss Tindall. Stasi is an excellent student. A model teenager—honest, caring. Stasi is an individual. That individuality, that diversity, is very precious to her and to us. If you try to make her over in the image of some narrow ideal, if you try to squelch that individuality, we will have no choice but to withdraw our children from this school."

Miss Tindall's face went crimson. "That's illegal, Mrs. Jones."

"*Doctor* Jones," Helen corrected her. "And *we'll* worry about the legality of it. This is not a threat; please don't take it that way. We simply want you to understand that we are willing to go to great lengths to protect our children's individual rights. Stasi's qualities, Miss Tindall, are on the inside; they are not woven into her clothing." She looked at her husband, who was nodding thoughtfully. "I think we've done all we can here, dear. Shall we go?"

"Certainly." He rose and reached across the desk/barricade for Miss Tindall's hand. "Thank you for your time, Miss Tindall."

They left the cubicle, drawing the gazes of the office staff after them.

Royalty in khaki, thought Mildred Tindall, and wondered where they'd come from.

Constantine Jones had a problem. He had come to school without his book bag. He had no pencils, no pens, no paper and, worst of all, no textbooks. When the teacher asked the class to take out paper and a pencil, he sat, frozen inside, glancing nervously around the room.

Two rows to the right, Tahireh caught his eye. "What?" she mouthed. He shrugged and signed that he had forgotten the sacred bag. She looked thoughtful for a second, then pointedly lifted her desktop and put her own pencil in. Then she withdrew it.

Constantine knew what she was suggesting. He tried to swallow the lump of panic in his throat, but it wouldn't budge. "Here?" he mouthed.

"Constantine, paper and pencil, please," said Mr. Matthews.

"Yes, sir." Constantine lifted the top of his desk, reached inside and, after a moment of eye-clenched hesitation, pulled out a pencil and a piece of lined paper. Mr. Matthews smiled pleasantly and proceeded to hand out in-class assignments.

Everything was fine until he asked them to take out their history readers. Constantine panicked again. He could just say he'd forgotten his books, but that would mean a mandatory after-school session, an extra assignment, and

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utter humiliation before a council of his peers. His eyes cast about, clutching onto the boy next to him who had withdrawn the little textbook from his desk. It was covered in a crisp, brown paper bag.

Constantine echoed the movement, pulling out his own smartly attired book. His neighbor opened his book. He opened his, frowned in consternation, and quickly curved his arms around it.

"Page fifteen, please," said Mr. Matthews. "I want you all to take a moment to read page fifteen, then we'll talk about the New World."

Constantine put his head down and sweated. He could feel his sister's concern wash around and over him, felt it intensify to matching panic when Mr. Matthews took a bad turn and strolled up the aisle behind him.

Seeing a child hunkered so low over a textbook raises immediate suspicions in the mind of a teacher, and Mr. Matthews's teacherly instincts were about as fully developed as they could be. He stopped right over Constantine and looked down. Then, he tapped Constantine on the shoulder.

"How are we doing, Mr. Jones?"

"Fine."

"And what are we reading about?"

"The New World."

"Isn't it a little difficult to read about the New World all hunched over like that?"

"No, sir."

"Well, straighten up, please. We don't want you to ruin your eyes."

Constantine stared at him for a moment, a wrinkle of pure anguish between his brows. Then he straightened up.

Mr. Matthews reached over his shoulder and nudged the book out of his protective embrace. After a moment of silence, during which Constantine was certain the entire Cosmos had collapsed, Mr. Matthews drew in a long breath and said, "Mr. Jones, can you explain to me why the pages of this book are empty?"

Constantine, clutching his older brother's hand, cowered tearfully in the principal's office. The offending volume was in the hands of the enemy and all was lost. He had no true conception of the magnitude of his crime, but he was certain it would mean the end of the world as he knew it.

Beside him, Tamujin breathed confidence and comfort into the ether. "It's really very simple, sir," he said. "Connie just picked up the wrong book."

"The wrong book?"

"Yes, sir. That's mine."

"Yours? But it has blank pages."

"Yes, sir. It's a writer's journal. You know, a thought book. I got it just before we left Paris. Connie must have mistaken it for his history book. He'd wrapped that in a paper bag too, and they're about the the same size." He smiled engagingly. "I guess I should've put my name on it. Sorry, sir. I feel real bad about putting Constantine through this."

He squeezed his little brother's trembling shoulder and turned the smile down into his tear-streaked face.

Mr. Benoit looked at Tam for a moment, then turned his spectacled gaze to Constantine. "Well, no harm done, I suppose. Be more careful next time, young man. Check the contents of a book before you carry it to school."

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Outside in the corridor, Constantine's gratitude was effusive.

"Whatever possessed you to *do* that?" Tam asked, completely ignoring his worshipful elegy.

"Tahireh."

Tam looked down and shook Con's shoulder. "Try again."

"I forgot my book bag and the rule says if you forget your books, you have to do penance."

"Oh, yeah," Tam conceded. "I do recall that, now that you mention it. So, you just thought you'd go for a lesser penalty?"

Constantine glowered. "I didn't *mean* to get caught."

"Who does?"

"Do you think they'll tell Mom and Dad?"

Tam shook his head and rolled his eyes. "You'd better hope not. You know the rules about 'importing technologies across cultural boundaries.' Dad would have a fit."

Constantine stared down the empty corridor toward the distant classroom. "Yeah, he sure would."

"Miss Tindall *hates* me," said Stasi. "*What* did you *say* to her?"

Helen blinked. Next to her, her husband echoed the movement, staring at his eldest child as if she was an anthropological specimen that had suddenly risen up to protest being dug out of the ground.

"We just warned her about undermining your individuality," said Helen. "That's all."

"Well, now she's treating me like—like a *pariah*. She won't call on me unless I'm the only one with my hand raised, and even then she won't look at me or smile at me or *anything*."

Helen glanced at Troy, who was glancing at his notes as if he was preparing to dive back into them. She caught his eye predive and he shrugged.

"If it gets too bad, we'll talk to her again," he promised.

"Oh, great!"

"Now, Anastasia, your father and I were only trying to help."

Stasi had the grace to look contrite. "I know, but I'm afraid she'll *flunk* me or something."

Her mother laughed. "Good heavens! Why worry about something as trivial as that? It's not like she's actually *teaching* you anything. A local educator's arbitrary marks aren't going to affect your degree, honey."

"I know, but you can get black marks for failure to acculturate. She might make Professor Amadiyeh think I have a bad attitude."

"We'll tell him otherwise."

Stasi was silent for a moment, feeling incredibly freighted down and lonely. Thinking about Professor Amadiyeh made her think of Home and Danice Patten and all the other friends that now seemed light-years away. Friends she couldn't reach by land or by sea or—

"Can't we please go Home?"

Her mother looked sympathetic (she always looked sympathetic) and said, "Stasi, honey, your father and I are in the middle of a Project."

"Can't you finish it at Home?"

"How can we study the culture in and around military installations in Post World War Two America without having access to those installations?"

"Couldn't you use QuestLabs as a

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home base and just pop into a military base when you need to look at one?"

Her father laughed. "Stasi, you crack my mind! Do you have any idea how prohibitively expensive that would be? We blow over a hundred grand every time we power up the Grid, hon. Just settle down and enjoy Papillion, OK? It's not such a bad little town. When we're done here at Offut, I'll see if we can't cut straight to the Pentagon. You kids'll love Washington D.C. Now, why don't you go study before dinner?"

She stared at him, at her mother, already bending over the thin plate display in her hands, scanning faux-3D pictures of military personnel in their monotone uniforms.

They're so happy, she thought. *Like two kids in a sandbox*. She went upstairs. On the second floor landing, Tam met her.

"Secret meeting of the Jones Gang," he said. "My room. Five minutes."

"Thank you, Bugsy Malone," she said.

Tam deflated. "That was my best John Wayne."

"John who?"

"God, a cultural illiterate. You'd better bone up on your Twentieth Century films."

"Yeah, yeah. What's the meeting?"

Tam pointed at her nose. "It's a secret. Be there or be a rhombus." He turned and headed downstairs.

Five minutes later, they shared soda pop and greasy potato chips on the floor of Tam's room. Of the four, only Tahireh seemed disinclined to glower.

"I guess you're wondering why I've called you here," said Tam, munching.

"Get on with it," growled Stasi.

"I have an idea about how we might just possibly get Home before Mom and Dad retire."

Stasi snorted. "Oh, this should be good. We're gonna mutiny and take over the Grid Controller, right? Tie up Mom and Dad and slam this baby into reverse."

"Close." Tam took a swig of soda, looking arch.

"Well?" prompted Constantine. "C'mon, Tam. I could be out catching bugs, y'know."

"Mutiny," said Tam deliciously, dangerously.

"Mutiny," repeated Stasi. "Where'd you get a fuzz-brained idea like that?"

"Actually, I got it from you and Connie."

"*Con*."

Tam toyed with a chip crumb on the hardwood floor, scooting it around and around with his finger. "Have you ever wondered what would happen if we didn't try so hard to fit in wherever we go—if we sort of, oh, had trouble blending into the landscape?"

Stasi looked at him—hard. "Go on."

"What would Mom and Dad do if these little settling-in problems kept happening—maybe even got worse?"

"Ignore them?" suggested Constantine.

"They might try." Tam shrugged. "But if it got *really* bad and the teachers *all* got in an uproar and the Education Council got wind of it—"

Stasi's face finally lit up. "Professor Amadiyeh! If we all flunked out of school or started upsetting the local coal cart—"

"Apple cart."

"I can have any kind of cart I want,

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thank you. He'd have to get involved, wouldn't he? I mean, after all, it's his responsibility to see that our educational environment is sound."

"Yeah." Tam agreed pleasantly.

Constantine just folded his arms and smiled.

Between them, Tahireh, clutching a favored doll, stared at her siblings in horror. "Oh, you *can't!* You can't do something like that. Why, Mom and Dad would be . . . Well, they'd think there was something *wrong* with us."

"There *is* something wrong with us, Tahireh," said Stasi. "We're from another century, another *world*, almost. We don't belong here. We're . . . an anachronism."

"But Mom and Dad are so happy here!"

"Mom and Dad are happy anywhere they can dig up something or write papers about it," said Tam.

"But it's not fair for us to ask them to give up their work."

"We're not asking them to give up their work, Tar. We're just asking them to reorganize it a little."

"Reorganize?" repeated Tahireh dubiously.

"Yeah," said Tam and munched another handful of chips.

No one in Papillion, Nebraska had ever seen an outfit like the one Anastasia Jones wore on a particular Monday. The ankle-length jumper was a deep shade of burgundy that rivaled its wearer's hair. That hair was caught up in a fluorescent green clip on one side of her head, forming a stiffened fan. From her ears dangled the most amazing set of orange and green "giant fishing lures" imaginable, and the shirt she wore was of a shade of orange almost never found in nature.

Heads turned the moment she took off her jacket and stuffed it into her locker. They kept turning as she paraded the halls on her way to class. She smiled at Miss Tindall's ogling first glance and ignored the whispered wise-cracks of her classmates. When, during a morning study break, Miss Tindall called her into the hall again, she was calm, smiling, amiable.

"Yes, Miss Tindall?" she said sweetly.

"I thought your mother bought some new clothes for you."

"She did."

The teacher made an uncertain gesture. "Well, then—"

"I like *these* clothes, Miss Tindall. They . . . suit me." Her smile widened. "Don't you think?"

"I'm not sure they're suitable for school." Miss Tindall was making a gallant attempt to sound kind and wise.

Stasi looked bemused. "Why not? Is there a rule against them?"

"Well . . . no, but they *are* distracting to the other students."

"That's not my fault, is it? Besides, I think they'll get used to it."

Miss Tindall frowned. "That's a poor attitude, young lady."

"Why? I'm not breaking any rules and I'm not hurting anybody. I'm just being myself. What's wrong with that?"

Miss Tindall sucked in her lips and fixed Stasi with a look that might have frozen a lesser fifteen-year-old on the spot.

Stasi smiled.

Miss Tindall tried another tack. "Stasi,

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dear, can't you hear them laughing at you? Don't you care if you become a laughingstock?"

Stasi thought about that. "No," she said.

"No," repeated Miss Tindall.

Stasi shook her head. "I'd rather be a laughingstock and be different than look just like everyone else."

"I see."

"May I go study now, please?"

Speechless, Miss Tindall opened the door and ushered her in.

Tahireh stood before her class with total aplomb, dressed in an azure linen sari that, with the lime-green shirt she'd elected to wear under it, made her look like an elongated peacock. Her blonde hair cascaded in a fountain from a tiny topless blue fez.

"When I Grow Up—an essay by Tahireh Jones. Ahem. When I grow up I plan to be a scientist like my mother. And, like my mother, I would like to have my first master's degree by the time I'm fifteen and my first Ph.D. at twenty—in physics, I think, quantum physics . . . or maybe particle physics. I think I'd like to get my degree at Stanford—that's in California. Then, I would like to go to Juliard and study drama and voice. It is my dream to someday portray the fearless saint, Tahireh, for whom I am named, in the play about her commissioned by the immortal Sarah Bernhardt. I also plan to write several novels, books of inspirational poetry, and academic volumes on travel in space and time."

She paused and thought for a moment, ignoring the titters of her classmates, then added, "I would also like to be one of the first full-time field scientists on Mars."

Now the class cackled in unabashed glee. Mr. Matthews stood and clapped his hands. "Class! Class! Please! I think we should applaud Tahireh for a very interesting and imaginative presentation. Now, seriously, young lady, tell us what you really want to do when you grow up."

"Everything I just said, although, I might like to study acting first."

Mr. Matthews smiled tolerantly. "But, Miss Jones, half those things are . . . just make-believe—going to Mars, time travel. And the others are not very realistic goals for a young lady. Don't you want a family? Children?"

"Oh, sure. If I fall in love with somebody, then I'll have that too."

The indulgent smile deepened. "Young lady, you can't do both."

"Why not? My Mom did. She says you can be whatever you want. She's got three Ph.D.s and her teaching credentials. She's written three books, too. One of them won the Nobel peace prize. I think I'd like to be the first author to win a Nobel prize for a science fiction novel."

"Science fiction," Mr. Matthews repeated. "I see." He looked around the room. "Who would like to go next?"

Pamela Harris wanted to go next. Pamela had been going to talk about being a beautician like her big sister, she said, and marrying someone who looked like Clark Gable and moving to Omaha, but she'd been having second thoughts. She decided she really wanted to be a cruise ship captain like her Uncle Jerry, or maybe even an Air Force pilot like her father. She wasn't really sure

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she wanted a family at all. At least, not until she was very old. She thought she'd rather travel all over the world and decide about a family later.

Out of Mr. Matthews's eleven female students, seven suddenly opted to grow up differently than they'd previously planned. The word "homemaker" came up only twice as a lifetime goal. Tahireh Jones suddenly had the young ladies in Mr. Matthews's third grade class talking about careers, degrees, and the equality of the sexes.

"About this paper, Mr. Jones." Mr. Schiflin pushed the three-page essay across his desk.

"Yes, sir?"

"I didn't grade it, because I wasn't sure what to make of it. I asked for an essay on the future of relations between the US and Europe and you gave me science fiction."

"Excuse me, sir?"

"You can't honestly believe what you wrote here. Why did you write it?"

"Of course I believe it, sir."

Mr. Schiflin rustled the top page. "A unified Germany? The US and the Soviet Union the closest of allies? A world government? English as a universal language?"

"Yes, sir."

"What makes you think the US will lose its super-power status?"

Tam shrugged. "It's inevitable, isn't it? If we're to achieve world unity, there really can't be any so-called super-powers—at least, not the way we're used to thinking of them. We have to give up some sense of sovereignty to become a working member of a community made up of equal nations."

"There are those who would find that view unpatriotic or un-American. I just find it absurd. I'd like you to rewrite this essay, Mr. Jones, from a more realistic point of view."

"I can't, sir."

Mr. Schiflin fixed him with a positively deadly over-the-bifocals stare.

"This is the way it's going to be. . . . I believe. If I wrote something else, I'd be lying. You don't want me to lie, do you, sir?"

The stare waxed more deadly. "Perhaps I need to have a word with your parents about this, young man."

"Perhaps you do, sir," returned Tam agreeably.

Tuesday, Constantine forgot his pencil bag. He stared at the empty paper before him on the desk, arms folded, stoic.

He could ask the teacher for a pencil, but that would lay him open to ridicule and perhaps even discipline. He could signal Tahireh to toss him one of hers, but she'd probably get caught doing it and made to stand against the wall for throwing things in class. He could ask Bobby Truman to lend him one, but then he'd get caught whispering. That drew a stiff oral presentation on a randomly selected subject.

Then, again, he could always manifest a pencil—they were easy and nondescript—but he'd promised Mom and Dad he wouldn't. When he and Tam had told their parents about the blank book incident, a definite rule was established: no manifesting of books, pencils, or paper. Period.

Constantine had mumbled something about stifling the development of his

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God-given talents, but the rule stood—Constantine was not to manifest so much as a paper clip.

But I don't need a paper clip, he thought, *I need—*

"Constantine, begin working on the problems, please."

He glanced up toward the front of the class. Mr. Matthews gazed back, pointedly tapping his wristwatch. Constantine dropped his eyes and glanced quickly around the room, taking in the hunched figures of the other children—scribbling madly, eraser chewing, pencil tapping.

A slow smile tugged at the corners of his mouth. He glanced at his open math book, then set his gaze purposefully on the empty paper beside it, the first set of figures indelibly impressed on his mind.

Mr. Matthews started wandering several minutes later, weaving his way along and through the rows of struggling students, checking their progress or lack thereof. One of them sat unnaturally straight, eyes on his paper, smiling, hands folded inactively in his lap.

Matthews worked his way quietly toward the immobile child, snuck up behind him and peered expectantly over his shoulder, mouth open to utter a terrifying, "And what are we doing, Mr. Jones?" But the words did not form. Mr. Matthews ogled in silent disbelief as a series of mathematical problems scrawled themselves across the sheet of paper as if by an invisible pencil. He gasped.

Constantine felt a chill of mixed terror and elation as he heard Mr. Matthews's breath catch in his throat, sensed his blood cool suddenly in his veins. The child-smile deepened.

* * *

"He hasn't told *anybody*," said Constantine. "I know he hasn't. And it's been three days."

Tam wrinkled his forehead. "Well, Mr. Schiflin talked to Dad about my essay. Dad said I should be less direct in my revelation of future events. He assured Mr. Schiflin that I wasn't un-American, just unusually perceptive and cosmopolitan. I'm not sure Schiflin even knows what cosmopolitan means. How're you girls doing?"

Tahireh drew herself up and smiled, tossing a thick blonde braid over her shoulder. "I've got almost every girl in our class thinking about what college they want to go to and what degrees they want to get." She exchanged the smile for a puzzled frown. "But I don't really understand how that's supposed to upset anybody."

"Oh, it will, Tar," Tam told her. "You'll see."

"I'm not so sure," said Stasi dourly. "I think maybe Mom and Dad awed the administration so much, they're just gonna grin and bear it. Miss Tindall hasn't batted more than an eyelash since our last talk. Elaine and a couple of the other girls have even started to dress like me, and Beth Silverberg did something weird to her hair and Tindall just said, 'My, that's unique.' "

"Yeah, but Schiflin—"

"You handed in an essay that offended the man's sensitivities. That's not enough to get you in trouble."

"Then we need to bolster our offense."

Stasi shook her head. "We can't do anything *really* bad, Tam. At least, *I* won't."

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"Me neither," vowed Tahireh.

"I wasn't even going to suggest it. I just think we need to give them something they can't ignore."

Tamujin Jones handled his fluorescent orange and blue gravi-pack with cheerful confidence, showing everyone who cocked an eye at the bright satchel that it was light as a feather despite the fact that it obviously contained every textbook he owned. He stopped to let this one touch the sleek, shiny material; grinned as that one hefted it, finding it to be much lighter than it appeared to be; laughed outright when one especially curious young citizen removed a book to find that the single volume weighed more than the entire packful he had just taken it from.

"It's what they make parachutes out of," Tam told anyone who asked. "And astronaut's uniforms."

"Astro-what?" asked one freckled peer.

"Space suits," Tam said and grinned.

"So what else do you carry around in that 'space bag' besides books?" asked the boy who sat behind him in class.

He tried to look coy, secretive. Stasi was better at that than he was. "Oh, not much," he said, and floated the pack into his lap.

His classmates' curiosity was suitably whetted. They watched the pack as if it might hold a football autographed by the Cornhusker's starting quarterback. They were forced to take their eyes from it as class progressed, but Tam brought their attention back from time to time by rummaging in it, extracting a pencil, a notebook, his English text.

When Mr. Schiflin began to lecture on their English assignment, Tam set his pencil down in the midst of note-taking and glanced furtively around. Then he opened the pack and extracted, with the air of a veteran safecracker, something small and black and mechanical; something that drew the eyes of his circle of watchers like a magnet.

He played it like a tiny piano—one handed—then scribbled, then listened, then played, then scribbled again. A whisper of curiosity rippled out from Tam's cast pebble, cresting within earshot of the lecturer. Schiflin, interest engaged, took his show on the road, wandering the depth and breadth of the classroom.

Tam let him come within two rows before he slipped the enticing object back into his pack. The teacher covered the distance between them in two strides, every eye in the class following him.

"What was that, Mr. Jones?"

Tam looked up, wide-eyed, and smiled affably. "What was what, sir?"

Schiflin pointed. "You just hid something in that bag."

"I didn't hide anything."

"I saw him, Mr. Schiflin," volunteered Greg Rollins from across the aisle. "He was playing with something. A puzzle, I think."

"What was it, Mr. Jones?"

Tam shook his head. "The only thing I put away just now was my pocket dictionary."

Mr. Schiflin's pointing hand turned palm up. "Give it to me, please."

"I was just taking notes and needed to look up a word—"

"Hand it over. Now."

Tam hesitated just long enough to

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make Schiflin's face turn red, then he withdrew the curiosity from the satchel and laid it across the teacher's outstretched palm.

Schiflin turned the thing over, frowning at it. "What is this, Mr. Jones?"

"I told you, sir. It's a dictionary. I was looking up words from your lecture."

Schiflin stared at him. "A dictionary . . . If you don't mind, Mr. Jones, I think I'll just hold onto this 'dictionary.' And I'll expect you to deliver a note from me to your parents."

"Yes, sir."

Mr. Schiflin started to turn away, then glanced back. "How does this work?"

"You just turn it on—the little red switch at the top. Press it; it turns green to show the unit is on. You press it again to turn it off. To look up a word, you can either enter it from the keypad or just tell it."

"Tell it?"

Tam nodded, enjoying himself much more than he knew he should. He'd always wondered what it would be like to take Jules Verne for a ride in a hoverlite or show Edgar Allan Poe a computer. This had to be almost as good. "Just say the word," he said.

Schiflin frowned, then reddened. He glanced around the room as if he'd only just realized how big an audience they had.

"C'mon, Mr. Schiflin!" urged Greg. "Try it. I'll bet he's full of it!"

Schiflin didn't even censure the outburst. "It would serve you right, young man, to be caught with your pants down."

"I'm not lying, sir. I promise. Give it a word."

Scowling, Schiflin pressed the red button. It turned green and a tiny, flat, black screen the size of a business card displayed the words: "Dictionary Mode." Below that was: "Input Word?" He held the thing close to his mouth and said, "Outrageous."

The screen filled with text. "Outrageous," echoed his own voice. "Grossly offensive, disgraceful, shameful, extravagant, immoderate. Shall I spell it?"

Face white with small patches of intense red at the cheeks, Schiflin stared at the tiny machine. "Shall I spell it?" asked the pleasantly aqua screen text.

"No, thank you," he answered, and felt immediately stupid.

Tam sensed his anger warring with wonder, with curiosity . . . with fear.

The bell rang, jolting everyone out of the shared stupor. Still, no one moved. Mr. Schiflin cleared his throat. "Class dismissed for lunch. Mr. Jones, you may go home."

"Why, sir? I haven't done anything wrong. It's all right to look up words—you said so."

"In a *book* not—"

"It's just a dictionary, sir."

"It's more than a dictionary, Mr. Jones. Even I can see that. What you've done is lied—boldly and outrageously. You have disrupted my classroom. And I can only assume, you've stolen this obviously valuable piece of equipment. Now, go home. I'll speak to your parents at their earliest convenience."

"I didn't steal it."

"We'll see about that."

Tam nodded. "Yes, sir. Whatever

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you say, sir." He gathered his books into the mysterious pack and left the campus.

He managed to get into the house without being seen by either parent. That wasn't difficult. Troy Jones was at the Air Base posing as a scientist of some sort and his wife was cheerfully working on the text of their research somewhere in the Lab/Office.

When the others came in at 1630 hours, Stasi had her friend Elaine and two other giggling girls in tow. Tam came out to the landing, giving his sister the thumbs-up sign as she entered the front hall. She returned it, looking purposefully intense and sporting a twisted, half-manic grin.

"Hi, Mom! I'm home!" she called through the front parlor. "I've got some friends with me. We're going up to my room to do some homework, OK?"

There was a moment of silence, then Helen Jones's voice came back to them from the "restricted area." "Is your room clean?"

Stasi's grin widened. "Yes, Ma'am."

"Well . . . OK, then, I guess."

"Thanks, Mom!"

The girls loped up the stairs, school books in arms, looking, Tam realized, like Anastasia Jones clones. Their hair was tugged off to one side in fans or sprays. Their Mary Jane shoes mimicked her astrolon flats. They wore what looked like their big sisters' hand-me-down skirts, and from every earlobe dangled earrings made of gaudy gewgaws home-mounted on scavenged clips and wires.

All in all, a most up-to-date group of young ladies—if the date was 2112.

Tam said, "Hi," and returned to his room.

"Your little brother's awful cute," observed Trudy Wessa, "for a kid," she added.

"I heard he got in trouble today," said Elaine. "Do you know why?"

Stasi dumped her books on her desk and flopped into her study chair, a fulsome papasan they'd picked up in Japan. "Gosh, no," she said, wide-eyed. "I didn't see him at lunch, though."

"I heard he got caught with some kind of Air Force secret weapon," offered Beth.

Elaine glared at her. "I heard it was just a toy."

Stasi laughed. "Sure. What's my little brother doing with an Air Force secret weapon?"

"Well, your dad works at Offut, doesn't he?" asked Beth. "Maybe he brought something home and Tam just . . . borrowed it."

"Tam wouldn't do that."

"Well, Mr. Schiflin was real mad," Trudy interjected. "I saw him talking to Mr. Benoit about it while I was in the administration office this afternoon."

"Sounds like you *heard* him, too. Eavesdropping, were we?"

Trudy figured Elaine's smirk warranted retaliation. She grabbed a pillow from under Elaine's elbow and smacked her with it, sending her on a giggling roll against the headboard.

"Ow!"

Elaine sat up again, rubbing her elbow and glowering at the two very hard objects it had connected with. Her expression changed immediately. "Oooh, wow! What are these?" She

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abandoned the wounded elbow in favor of checking out her find. "*Dune*, by Frank Herbert," she read. "Winner of the Nebula Award." She looked at the other one. "*Studies in Physics and Metaphysics* by Dr. Jamal Am-a-di-yeh." She glanced over at Stasi. "Those sound like book titles."

Stasi pretended embarrassment and leapt (belatedly) to collect her property. "Uh, they are."

Elaine swept them out of her way only to have Trudy grab one. "What are these? Some kind of ritzy slip covers?"

"Slip covers!" snorted Trudy. She tapped the one she held with her fingernail. "They feel like metal or plastic or something. What's this red button do?" Of course, she pushed it and the book opened and presented her with a full-page menu which enquired politely if she wished to go to the last bookmark and, if so, would she like a summary of what had happened in the story so far, or would she rather start at the beginning? Would she like the book in black on white or white on black or would she rather select colors from a palette? Did she want pictures as well as text? Did she want audio output in addition to visual? Would she like to print hard copy?

"Wow!" she said. "Wow! What *is* this? Did you get this in Paris?"

Stasi scratched her nose, hiding a grin. "San Francisco."

Trudy gaped at her.

"Who are these guys?" asked Beth. "Herbert and Ama— Ama—"

"Amadiyeh. Herbert's a science fiction writer. Dr. Amadiyeh is my educational counselor."

"Your what?"

"I thought Mrs. Hester was your counselor," said Elaine, "same as me."

"Well, this is different. This is for my, uh, home study program. You know, supplemental education."

Beth nodded. " 'Cause you're a Brain, right?"

"Something like that." Stasi reached for the books again.

"2100 edition," Elaine read. "Another Cyber-Book from—"

Stasi snatched the volume from her hands. "We'd better start on our skit." She tossed the books into a drawer of her dresser. Three pairs of eyes locked on the drawer.

Elaine giggled. "Are you from Mars?"

"Any idea what this parent-teacher conference is all about?" Troy Jones asked the general assembly, since there was nothing in the usual "to discuss (your child's name here)" blank.

Four innocent stares met him over the edge of the papers. He waved it in the air over his dinner plate. "Anyone care to claim this?"

The four innocent stares converged over the tofu loaf in a hasty, silent conference. Then, Stasi spoke.

That, in itself, was enough to give both Doctors Jones pause. A speech by the eldest child generally meant she had been elected ring leader which, of course, meant there was a ring to lead, which could only lead to parental aggravation. The Doctors Jones simultaneously recalled the last such occurrence, which had centered around the appearance of an unauthorized mongoose on the house manifest after a Shift to colonial India. The resulting furor in their

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quiet, well-modulated environment had gotten them and the mongoose evicted from their inner city condominium to a rambling house in the Berkeley hills.

"It's probably just further repercussions from Tam's disagreement with Mr. Schiflin," Stasi said sagely, then added, "although, Miss Tindall did talk to me the other day about my clothes."

"What's wrong with them?" asked Helen warily.

Stasi shrugged. "She thought they were a little, um, bright . . . different —you know, too individualistic."

"But I bought you some new skirts and blouses."

"I like my old clothes better sometimes. They remind me of who I am. Where I'm from . . . really."

"Are there some problems here we're not aware of?" asked their father.

Stasi and Tam shrugged in unison and glanced at each other.

"I got reprimanded for looking up some words during one of Mr. Schiflin's lectures the other day," offered Tam.

"Mr. Matthews didn't like the way I did my math problems," added Constantine.

Both Joneses Senior moved their eyes to Tahireh.

"I'm fine!" she said, and smiled.

Tahireh Jones was not fine. Not according to Mr. Matthews and a sampling of mothers. She was a fomenter of discord, a libertine, a Bad Influence. Parents had complained that the daughters they'd assumed would work at the library until they married and settled nearby now showed a sudden interest in the son's college fund. Some even showed an interest in his toys and books. Others played at being Sarah Bernhardt or Katherine Hepburn; their dolls gathered in audiences so entranced as to be left unblinkingly wide-eyed and speechless.

While Helen and Troy Jones, seated in the principal's office with that gentleman and a delegation of three teachers, pondered their response to those charges, Miss Tindall fired her volley. Their eldest daughter was an equally negative influence, encouraging the most ridiculous extremes in dress and hair styles. Distressed mothers wondered why their daughters had suddenly taken to ripping the hems out of their dresses and twisting their hair into shapes reminiscent of ornamental shrubbery.

Mr. Schiflin observed darkly that excesses in clothing were nothing compared to the sort of un-American, irreligious philosophy expounded by Tamujin Jones in his treatise on the future role of America in the free world. "And then," he said, pausing dramatically, "there's this." He reached into his pocket and withdrew—

"My God!" Troy Jones gasped. "Where did you—?"

"You recognize it, I see," said Schiflin mildly.

"Ah . . . that is, well . . . yes. It belongs to— That is, it's . . . a piece of my lab equipment."

"Really? Your son said it was his *dictionary*. May I ask how this obviously sophisticated piece of equipment came to be in the hands of a fourteen-year-old boy?"

"And how your daughter, Anastasia, came to be in possession of equally sophisticated readers written by unknown

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authors with no record in the Library of Congress?" added Miss Tindall.

"And how Constantine appears to be able to write *without a pencil?*"

"*What*?" Mr. Benoit and the other teachers stared at him.

"*I saw him*," Matthews said, his voice low. "I did not imagine it."

Helen tried to dart in before a panic ensued. "The children weren't supposed to—" she began and stopped. Weren't supposed to what—unleash future developments on your poor, unprepared, narrow environment? She glanced at her husband, who cleared his throat.

"In our line of work, Helen and I are . . . privileged to make use of many rather startling new technologies."

"Your line of work?" repeated Mr. Benoit. "And what would that be? Espionage?"

"Good Lord, no. We're research scientists—archaeologists, anthropologists, sociologists, historians."

"Come now, Dr. Jones. We've seen enough to know that you and your family are digging up more than bones. This equipment, what Beth Silverberg and the others saw in your daughter's room, the things your children have said and done, all lead to the obvious suspicion. You are Communist spies, *Doctor* Jones." Benoit sat back in his principalian throne, looking quite pleased.

"Absurd!" said Troy irritably. His gaze followed Tam's dictionary to the principal's desk, wondering how to get it back.

"Ridiculous," added Helen, and wondered the same thing.

"Is it? Even your children's names are foreign. Tamujin—that was Genghis Kahn, if I'm not mistaken; Anastasia—a member of the Russian aristocracy; Tahireh—the name of a Mohammaden suffragette—"

"That's Muslim," Troy corrected absently. "And she wasn't. She was a Bab'i."

"You beg the issue, Doctor. I suspect that what Mr. Schiflin has confiscated from your son is a top secret invention. The question is: Whose top secret is it? Ours or theirs? Did you steal it from SAC Headquarters or did you bring it with you as a tool of the trade?"

"If we'd stolen it," reasoned Helen, "we'd hardly let our son take it to school."

Benoit looked unconvinced. "Oh, but boys will be boys. Your son can't be expected to ignore such a curiosity. Or maybe . . . " He rose dramatically and paced around his desk to perch against the front of it, looming over them like a clumsy, cliché movie cop. "Maybe Tamujin *wanted* to get caught. Maybe he wanted *you* to get caught—to end the years of subterfuge and pretence, the years of lonely, trackless wandering." He gazed down at them soulfully, and was rewarded by their sudden, startled exchange of glances.

"Do you think—" asked Troy.

"I didn't realize—" murmured Helen.

"They must be more miserable—"

"Than we had any conception."

"I feel like such an ignoramus."

"And selfish."

"And sorry?" asked Benoit eagerly.

"Well, of course," said Troy. "Those kids must be desperate."

"We've got to do something, Troy," said Helen.

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"Sign a confession," urged Benoit, leaning over them.

Troy waved at him as if he were some buzzing insect. "Helen, have we been that—"

"Self-absorbed?" She nodded emphatically. "We owe those poor kids an apology."

"You owe this *country* an apology!"

"Maybe, but what they did was completely out of tune—underhanded. They could have *said* something."

"They *did*. They blew your cover!"

"They did, honey. They said a lot of somethings. We didn't listen. We were too busy being—"

"Spies?"

"Academics. That's what that mongoose was all about. They wanted a real home, not an antiseptic holding pen. They were happy at the Farm."

"Mongoose? Farm? What's that —code?"

Helen nodded, grimacing. "The Farm." She put her hand on his khaki-covered knee. "We need to talk this out with them. *Listen* to them. Compromise."

"You're already compromised," said Benoit.

"There's only one problem, Helen. We haven't finished our research in this time zone."

"Oh, you're finished in this time zone, all right, *Doctor*. And when Colonel Powers gets here—"

"Who?" Both Joneses turned their heads, speaking in perfect two-part harmony.

"Colonel Powers from Strategic Air Command, the Little Pentagon, the place you've been spying on." Benoit was obviously pleased to have finally gotten their attention. "I called when this all began to come together. He'll be here any minute to question you and to see this." He patted the dictionary.

"And do you suppose we'll actually stay around to meet him?" asked Troy.

Benoit looked as if he'd believed it up until that very moment.

"You're right about this," Troy continued, nodding at the dictionary. "It is, as you suspected, a highly sophisticated piece of equipment. It's not only a Russian-English translator, it's a communications device, which you have activated, signaling our operatives as to our exact location. And—" He snatched up the little machine, activated it, and turned the glowing green button atop it on the gaping principal. "—It's also a weapon—a laser beam gun, to be exact."

He rose, taking his wife's hand. "Come, my dear. The submarine is waiting." They backed toward the door of the office, keeping the startled teachers covered with the dictionary.

Troy opened the door and ushered Helen through. "Za mir," he said. "Oh, and Pazh'loosta."

"Here they come," said Tam urgently. He let the curtain fall back across the front window and headed for the kitchen.

"Wow, they're really trekkin'!" said Constantine, impressed with his parent's speed.

"They keep looking behind them," observed Tahireh. "I wonder if there's a mob after them like that time in Salem."

Stasi shook her head. "I don't see anybody. I think I hear sirens, though."

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"Hey, you guys!" shouted Tam from the direction of the kitchen. "Stations!"

Children flew in all directions, assuming nonchalant, relaxed poses; looking studious, looking bored, looking in the refrigerator for leftovers. The front door slammed open, then shut again, admitting two gasping, giggling adults.

"Stations, everybody!" Helen wheezed. "We're powering up!"

Galvanized, the kids followed their parents' trail as far as the dining room. There, they stopped to exhange bug-eyed glances, clinking invisible glasses over success beyond their wildest dreams. They heard the soft hum of the Grid coming on line and bolted as a unit for the Lab.

Their parents stood at the console; Father checking settings, Mother clearing an Emergency Shift through the QuestLabs Controller. The hum grew to a flute-tone—a warm wave of pure sound. The walls of the two-story brick house began to glow softly violet, to tremble, to run and change and remold themselves to vapor.

"We're on our way," murmured Helen.

"On our way?" asked Stasi. "On our way where, Mama?"

"Home," Helen said and turned to give her children a fierce grin. "Home, where you four will do some stiff penance."

"Penance?" asked Tam warily. "What penance?"

"Your father and I gave it some serious thought while we were galloping up that hill tonight."

"Serious," agreed Troy, eyes on his monitor.

"And?" Four children held their breath.

"When we get back to the Farm . . . " Their mother keyed a last sequence, depressed a final button. The walls melted into a glorious violet spray, ran to red, to sunset, to sun itself. Colors exploded in the walls; splashed and crested, then imploded becoming solid, opaque, mundane.

Helen Jones turned back to her children with a terrifying glare. "You're all grounded."

"Grounded?" The four pairs of eyes got wider.

"Grounded. No Temporal Shifting, no terrorizing small mid-western towns, no anachronistic dabblings."

"Never, ever again?" asked Tahireh, her brow furrowing.

"Well," the Doctors Jones traded glances. "Maybe . . . " began Helen.

" . . . during vacation," finished Troy.

Tam was troubled. Now that he had what he wanted, he wasn't sure he should have gotten it. "But Dad, what about your work?"

"We'll just have to adapt, compromise. But we will *not* compromise on your . . . discipline. You heard your mother. You're grounded. Right here, in Twenty-one—um," he checked his chronometer, "Thirteen."

The four pairs of eyes blinked. The taciturn Constantine let out a jubilant whoop. Tahireh giggled. Stasi hugged both her parents.

"Thanks, Dad! Thanks, Mom!" said Tam. "C'mon, you guys, let's go check out the old neighborhood."

The noisy rabble rolled out of the Lab, through the house and out the front

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door. The elder Joneses followed their progress with the delicate sonar of parenthood.

"Extraordinary," said Troy. "We've spent our lives *studying* history, but today was the first time we've actually *made* history. Do you realize that for the first time since the birth of the Universe, children were grounded and *liked* it?"

Helen looked thoughtful. "An interesting phenomenon. We'd be delinquent not to record it for posterity."

"A research paper?"

"Why not a book? *The Effects of Temporal Shift on Adolescent and Pre-Adolescent Development.*"

Troy Jones nodded, experiencing that peculiar, warm, fuzzy feeling he always associated with love and new projects. "I like the sound of that," he said.

* * *

Out under the autumn trees, Stasi and Tam surveyed the familiar and found it wonderful. Not far off, Tahireh and Constantine rolled in the grass of Home, giggling.

Tam took a deep breath. "Dad got the dictionary back," he said. "I saw it on the Console. It's kinda weird, thinking how close we came to making an indelible mark on history. It'll be a relief when QuestLabs perfects that Anachron Object Recall System."

Stasi's mouth did funny things at the corners. "I hope they perfect it soon."

"Huh? Why? I just said Dad got the dictionary back."

"Yeah. Well, I did something sort of . . . dumb." She glanced at him out of the corner of one eye. "I lent Elaine a book." ■

●The Earth: a globe ceaselessly hurled into the Universe to annoy the heavens.

Elias Canetti, 1957

●What is a good education, if not the means of achieving all kinds of pleasure without danger and without hindrance?

Denis Diderot

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the reference library

By Tom Easton

Nothing Sacred, Elizabeth Ann Scarborough, Doubleday Foundation, $21.95, 342 pp.

Bone Dance, Emma Bull, Ace, $4.50, 279 pp.

Death Qualified, Kate Wilhelm, St. Martin's, $22.95, 438 pp.

Tehanu, Ursula K. Le Guin, Bantam, $4.95, 253 pp.

Beggars in Spain, Nancy Kress, Axolotl Press (Pulphouse Publishing, Box 1227, Eugene, OR 97440), $10 (pb), $35 (hb), 104 pp.

A Roil of Stars, Don Wismer, Baen Books, $3.95, 281 pp.

The Time-Lapsed Man, Eric Brown, Drunken Dragon Press (84 Suffolk Street, Birmingham, B1 1TA, England, £13.50, 216 pp.

Books on Disk

When I wrote last month's column, I included a remark that the Gulf War might last for months. Happily, it didn't. In fact, it was over almost as soon as I mailed that column off to New York, and with results that have to make it one of the most lopsided wars in human history.

I am pleased with those results. So, I am sure, are all those writers and readers who dote on shoot-'em-up-bang-bang space opera. Their favorite kind of science fiction has gained an enormous amount of credibility. At the same time, public reactions to the war say something about why that kind of SF (and other violent fiction) is popular.

I'm thinking of the delight America takes in military prowess. I'm thinking of the grins on the generals' faces as they talked about all the nifty toys they had for their sandbox games and the nifty things they would be able to do with those toys, and then the even bigger grins when those nifty things all worked out.

This is not to denigrate the effectiveness of the Patriot missiles in saving

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lives, or the justice of knocking a petty Hitler back into line. I myself am glad that things worked out the way they did. I, too, am proud of American technology and American soldiers and American determination.

But it is very clear, despite all the rhetoric, that Americans are not all that peace-loving a people.[1] And there are *so* many opportunities for military adventuring—with joy and delight—of precisely the sort we love best. Just think—Israel could use a little joyous guidance in its relations with the Palestinians. Greece and Turkey could benefit from being picked up and shaken, and Cyprus offers the perfect venue for the shaking. There are South Africa, Lebanon, Southeast Asia. And if we want to dance with the Big Boys, there are the Baltic nations and China. That is, there's a *lot* of fun to be had out there, and it has the grand virtues of serving truth, justice, and the American Way while saving the oppressed and stimulating the economy. It's having fun while doing good.

Yes, I'm sounding very cynical.[2] But I am not nearly as cynical as Elizabeth Ann Scarborough can get. She began her writing career with fairly light and frothy fantasy (e.g., *The Drastic Dragon of Draco, Texas).* Then she wrote the powerful *Healer's War*. Now she offers us **Nothing Sacred,** which posits a 2069 in which the USA, as the North American Continental Allied Forces, has so bloated its military adventurism that it fights on *both* sides of every conflict in sight in the name of fairness and peace (levels the playing field, don't you know?). The price of such civilian amenities as education is out of reach for all but the rich, you need an MBA to be a bartender, and there's no welfare system anymore, but the army takes everyone. Want to eat? Join up.

And thus Viveka Jeng Vanacheck, descendant of flower children, with her three undergrad degrees, becomes a soldier, assigned to operate a mapping computer until her spyplane is shot down over the Himalayas. Captured, interrogated, and shunted mysteriously off the normal POW track, she soon winds up in an isolated Tibetan valley where a bomb-triggered avalanche had long ago destroyed some vast complex of buildings. Vivid dreams give Viv a sense of the lamasery or city that once adorned the valley. Viv's fellow POWs include Americans whose memories of the "real" world don't seem to match up with her own very well. They have been there for a long time; they also have heroically life-oriented records. There are also POWs from other nations. And both POWs and guards are busily engaged in digging out the ancient ruins, rebuilding wherever that is possible.

This much is clear by the time a quarter of the book is past, and it is enough to reveal the secret Scarborough does not spell out until near the very end: The ruins are those of Shambala, Hilton's Shangri-la, the holy center of the navel of the world, where some spiritual force protects wisdom and fosters health and long life. Wisdom, trashed by war, struggling to be reborn even as war intensifies and. . . .

Nothing Sacred is intensely realistic in tone and effect despite a gradually swelling vein of fantasy that ultimately and definitely denies the title. The fan-

[1] Face it: *Humans* don't seem to be all that peace-loving a *species.*

[2] Judging from the mail Stan and I get, some of you will be utterly outraged by at least some of what I've just said. Therefore, let me say now that there *is* an element of facetiousness in my words. I'll leave it to you to figure just how far into my cheek I've stuck my tongue.

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tasy component occasionally strains our suspension of disbelief, as does the moment when we glimpse the line between fantasy and reality, but overall this book stands as a high achievement of the metaphoric art. There is hope for the world. The POWs are in this camp for a reason. The guards are not what they seem, and their leaders have their own motives that have little to do with those of their ostensible masters. And the characters are people with whom we can all identify. Scarborough deserves a round of vigorous applause.

Emma Bull's **Bone Dance** also has a mystic component, but I found it harder to accept than I did Scarborough's, perhaps because Shangri-la has not been as heavily exploited as voodoo. Yet what Bull is doing in her book is every bit as interesting and significant, and the end result as worthy of applause.

Like Scarborough, Bull begins with the prosaic. Her future is decades after the holocaust, an event somehow shaped or contributed to by the Horsemen, individuals with the ability to take over others' heads; they were used by the US government as spies, high-level saboteurs, and so on. Her protagonist, Sparrow, is a video nut who makes his living finding old video tapes and selling them to collectors, such as a certain ruler of the City. Sparrow also contributes skill and time to the Underbridge, an informal nightclub heavy on classic video and music. Strangely, he occasionally wakes up with no memory of recent hours or days. In search of answers, he goes to a woman who uses tarot cards to reveal a weird fortune and recommend that he step out of himself a bit, engage himself in others' lives, for "there's a wind that's trying to blow." And then strange people begin to chase him. A new friend turns out to have been shot dead well before Sparrow met him. Another reveals herself as a repentant Horseman out to destroy the colleague who tyrannizes the City. The storm clouds gather, and indeed the wind begins to blow.

There is an ethical dilemma inherent in the Horsemen's existence and use by government. If there is any justification for or value in their use, there must come a time when they are no longer needed. How do you retire them? Do you—*can* you?—destroy them? Do you commit the psychic equivalent of rape or murder to give them a peacetime host? How do you keep them from moving on later? The answer, for Bull, lies with biotechnology: clone mindless bodies—*chevaux* or horses—their brains loaded with facts but devoid of personality, and keep them on ice until a Horseman wants one. But war destroys all plans. The storage facility is forgotten. Eventually, it breaks, and Sparrow is released upon the world to build a personality without the aid of parents or peers. He is—and note his involvement with electronics—something of a robot, and his story is that of an automaton who acquires not intelligence but social identity, commitment, involvement, who becomes a person. Along the way he must be ridden by Horsemen both male and female (parent figures, perhaps) and by the loa of voodoo (standins for the cultural icons that help to socialize us all.)

At the end, of course, the king is dead, Sparrow is fully human, and a life awaits. That life promises to be interesting enough, but I do not expect a sequel. Bull's present story is far too complete for that.

Kate Wilhelm begins her latest novel, **Death Qualified,** by asking you to meet Tom. He's a maintenance man who

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struggles against regular doses of some stupefying chemical to recapture an identity that he left behind years before. He leaves himself little notes that say *Don't take the medicine*. Eventually he succeeds long enough that his wits begin to return. He conceals the change from the Drs. Schumaker and Brandywine and Margolis who rule his life. There are hints that his predicament began in an incident involving a computer, disks, just enough strange science to warrant reviewing the book in a science fiction magazine (even though it's subtitled "A Mystery of Chaos"). Perhaps he did terrible things. And his name is really Lucas Kendricks.

Now meet Nell Kendricks. She and her two children live beside an Oregon river, not far from Wilhelm's own Eugene. She trysts with Doc, a neighbor whose wife, confined to a wheelchair, knows more than she lets on. Her husband, Lucas, was once involved with academics doing strange things. He left and never returned but once, just long enough to sire the daughter he has never seen. Now, she hears, he is on his way back. His parents have seen him. A computer is delivered to her doorstep, apparently from Lucas and definitely to her teenaged son's delight. And look! There's a woman's mangled body in the river!

When two men try to cut down one of Nell's prize trees, she demonstrates that she is a crack shot. Later, she goes for a walk in the woods. Lucas appears, laughing and happy. There is a shot, and he is dead. Nell, of course, is charged with murder.

Now meet Barbara Holloway. She is a lawyer who got so fed up with the mutual exploitations of "civilized" life, as represented by the scheming and dealing of the law, that she walked away from her legal career. Now her lawyer father has invited her home. He has been engaged as Nell's defense, but he can't handle it. Barbara can, can't she? She's qualified to handle murder cases—"death qualified"—isn't she? So won't she?

Of course she will. She will even find out who was spying on Nell with a gadget up a tree, and why. When Nell finally discovers the hidden bag full of tapes and computer disks, she will play the tapes and learn something of what Lucas went through and where Lucas was all those years and that he had not abandoned Nell, but was kept away against his will. She will discover a secret history of mind-alteration experiments performed on teenagers, with disastrous results. She will deliver a grand courtroom performance, and then, almost too late, she will discover that the bag Nell found held computer disks as well as tapes. Where are the disks? At home, with the kids. Quick! Send Barbara's computer-specialist lover, Mike, to fetch them.

Who really shot Lucas Kendricks, and why? Remember that misdirection is the heart of mystery writing. Remember too that Kate Wilhelm is a supremely gifted writer. When she chooses to echo the classic Perry Mason courtroom drama, she does a fine job, certainly surpassing the classics in the life she gives her characters. The reader comes to know them and to care about them. Yet I cannot help but feel that Wilhelm's central point here is less mystery or courtroom or characters than it is a beloved Oregon landscape. The book savors that landscape, dwelling long and lovingly on its details, and the plot stretches out until the reader cries impatiently, "Get on with it, dammit!" That is, the greatest shortcoming of *Death Qualified* is its pace.

* * *

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Ursula K. Le Guin is renowned for her novels both of science fiction and of fantasy. Among the latter is a trilogy of so much charm and depth and insight, that even though it was marketed as "children's" fiction, it found no such limits among its readers. That trilogy comprised *A Wizard of Earthsea, The Tombs of Atuan,* and *The Farthest Shore,* and it has been compared to the works of Tolkien and Lewis.

Like Tolkien, Le Guin wound up being badgered for a sequel. Eventually—when she realized that there really was more of the tale to tell—she succumbed. The result is **Tehanu.** The protagonist is Goha, a woman who was once the Tenar whom the wizard Ged (once known as Sparrowhawk) rescued from darkness in *The Tombs of Atuan.* After her rescue, she stayed and studied lore awhile with Ged's one-time mentor Ogion before retreating to the countryside to marry a farmer and raise a family.[3]

Now the farmer is dead. The family is grown and gone. Goha has only the waif Therru, hideously scarred both physically and mentally when her father and his friend raped her and beat her and threw her in the fire. And now Ogion summons her to his deathbed.

Before Ogion dies, he utters certain portentous words about Therru. After, a dragon arrives bearing a disempowered wizard, no longer Ged, only Sparrowhawk, whom Goha must nurse back to health and then send off before the new king's men, searching for Ged to honor him in their way, can find him. There is a rumor of a woman who has all the potencies of dragons. There is conflict between the forces of love, justice, and fairness on one side, and those of hate, greed, and tyranny on the other. There is a hint of utopian androgyny, the idea that age can bring nurturance and aggression (femininity and masculinity, if you like) into better balance in both men and women. To see that same combination in youth is rare; when it appears, it seems the mark of extreme wisdom.

I dare not say much more about the story for fear of spoiling your enjoyment. Much of *Tehanu* is built of small events, homey material, hearth and garden and petty encounters. Yet the small is touched by the large to the extent that the reader feels a part of something grand. This book and its three predecessors form a whole to cherish.

But is it really a whole? Is the "Earthsea Cycle" really over? Le Guin has said it is, but she said as much before. And as *Tehanu* closes, there is obviously room for more. Perhaps in time Le Guin will see fit to give us all another gift.

Nancy Kress' **Beggars in Spain** is a readable, reflective, argumentative novella that will not leave you feeling cheated but does suffer a bit because the author's point seems to have been argument more than story. The tale begins when dynamic rich man and ornamental wife meet the genetic engineers to order the latest thing in kids. The result is Leisha Camden, whose gene alteration makes her immune to sleep, highly intelligent, eminently sane, generally joyful, and even immortal. For contrast, Kress gives Leisha an ordinary twin sister, Alice. She then follows Leisha as she grows up, meets other Sleepless, discovers the jealousy and hatred of the outclassed Sleepers and struggles to save her kind from obliteration.

[3] I wouldn't put it past Le Guin to be using a certain routine pun of classic English lit to comment on women who abandon the delights of learning for those of marriage.

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The point enters in the Yagai philosophy, which views all human interactions as matters of trade. The Sleepless, because of their talents, are like tourists in Spain, confronted by a horde of beggars. They can toss coins to one beggar, or a few. But to hundreds or thousands? What is the trade in such a case? How then can the Sleepless live in a world of Sleepers who are, to them, no better than beggars?

There *is* a smug, self-centered way of viewing the situation: When you help the helpless, you gain in exchange a sense of virtue, or righteousness, or self-liking. But Kress doesn't mention this. "What goes around, comes around" and "Cast your bread upon the waters, and it will return a hundredfold" get a little closer to her point. Sadly, that point is made in a terminal moment-of-insight monolog that brings the story's action to a floundering halt much as a swamp might halt a cross-country runner. I suspect "Beggars in Spain" is part of a novel, and the monolog either will not be present or will not obtrude because it won't be the end.

Tales of persecuted supermen have been a staple of this field ever since its dawn. Kress' is well done, with a modern sensibility and a careful avoidance of the common claims that the supermen are bound to win, or must flee to the stars, or will inaugurate a tyrannical elitism that must be overthrown.

Ryne Sangre is a young fellow whose fondest wish is to get laid again and again and . . . . Trouble is, he drools too much. He lives far out the spiral arm, in the Cloud, a cluster of societies founded some 1,200 years before by refugees from the Whole, a greedy, expansionistic matriarchy whose clout is rooted in genetically engineered psychic powers. The Roil is a mysterious cloud of stars, planets, gas, and dust with a reputation for gobbling ships that hang around too long. Both Cloud and Whole are interested in the Roil, and one day their ships meet. Soon war seems imminent, and Sangre becomes a reluctant part of the Cloud's military build-up.

We know young Sangre survives his difficulties, both personal and military, for Don Wismer begins his **A Roil of Stars** by telling us the book is Sangre's old-age memoir. He also reveals that the Cloud wins the conflict, apparently because of something this incompetent sex maniac does. *Roil* thus has elements of the classic stumblebum comedy, where all the errors somehow conspire to bring events to a happy end. Yet the tone is not entirely Wodehousian. Other characters have less humorous problems—Kitty, the fellow trainee whose greatest cross is her admiral mother; Lee, the woman whose parents vanished in the Roil while bringing a great Whole secret back to the Cloud. Sangre loves both, gets Kitty pregnant, and is ferociously manipulated by Lee. The admiral wants his head on a platter. The Whole, represented by a ten-year-old, super-powered Little Lord and her minion, not only wants to keep him and Lee out of the Roil but also wants to destroy Lee's parents—trapped in the depths of the Roil but still alive—and the secret they stole.

Wismer makes his hero suffer for his jacquasserie. He lets him learn as he is chased and chastened. In due time, he even lets the boy grow up. And yes, the Cloud does win because of what he goes through. But I won't tell you how. For that, you've got to read the book.

Eric Brown's **The Time-Lapsed Man** is a collection of eight stories, five of them from the British magazine *Interzone*. The strangest thing about the

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stories is that anyone thought them worth a book all their own. They're fairly good but only occasionally good enough to stand out beyond the imitativeness of the new writer. Most do not transcend the flash of drugs, plugged-in brains, bought-out telepathy, psychic starship propulsion, and other standard paraphernalia of some kinds of modern SF.

Many of the stories also suffer from a kind of scientific nonchalance that would not have been out of place in the 1930s. The title story, for instance, insists that the nervous system is so ununified a thing that one can have one's senses start reporting an hour late. Hearing warps first, touch last, and the time-lapse grows longer. In "Star-Crystals and Karmel," Brown combines mystic crystals with oversized human-alien hybrids that, at birth, explode the human mother's abdomen (hasn't he ever heard of a cesarean section?).

The two stand-outs are both new in this book. "The Inheritors of Earth" plays a bit with Wells' *Time Machine* to rescue the Neanderthals from extinction.[4] "The Girl Who Died for Art and Lived" combines several of the elements Brown explored in the reprint tales— the crystals and psychic starship propulsion, for two—to produce a moving portrait of a man who, having survived the destruction of his ship and the deaths of his crewmates and lover, has discovered a long way to make psychic art of his pain. Together these two stories suggest that Brown may before long produce something truly noteworthy.

BOOKS ON DISK

Kiel Stuart's novella **From Parts Unknown** is available from BPLAN Virtuals (P. O. Box 338, Waterville, ME 04901); you can get it, for IBM-compatibles only, on a 5.25-inch disk for $5 and on 3.5-inch disk for $6.

Should you get it? If you like Ron Goulart, you won't be disappointed. Stuart displays the same wacky sense of the world, the same warped logic, the same indubitable verve as she introduces Loewy Aston Calera, the 17-year-old captain of the trading ship *Mulholland*. Her crew includes an official clown. She has a BioBed programmed with the mind of a parrot and named Polly (perhaps because every ship has to have a ship's parrot and every bed has to have cracker crumbs in it). She is on the way to the world of Armbar to negotiate a deal that will give her masters control of a rare phenomenon, a "natural astronomical laser." And Armbar is a world that is organized around and dominated by . . . Well, its motto is "Without wrestling, life itself would be impossible." And when Captain Calera saves the planetary leader's life, she acquires the remarkably handsome champion wrestler, Wildfire Wylie.

If you've ever watched pro rasslin' on TV, you have some idea of the overall impression this one makes: It's theatrical and funny, and it moves so fast that you don't get much chance to slip your critical sense into gear.

ANADEMS

Those of you who are interested in writing SF may want a copy of **Writing Science Fiction and Fantasy,** edited by Gardner Dozois, Tina Lee, Stanley Schmidt, Ian Randal Strock, and Sheila Williams (St. Martin's, $18.95, 267 + x pp.). Some of the articles are reprinted from *Analog* and *Asimov's*. Others are from *Writer's Digest*, *The Writer*, and assorted writing handbooks. There

[4] The Wells takeoff or extension is a bit of *homage* that a great many writers have committed. I committed one myself once.

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are pieces by Robert A. Heinlein, Isaac Asimov, James Patrick Kelly, Jane Yolen, Poul Anderson, Connie Willis, John Barnes, Norman Spinrad, and the editors on how to write, characterize, humorize, plot, world-build, submit, revise, and more.

If you have a good how-to library and have been reading the Davis magazines for enough years, you've seen much (but not all) of this book, but now you can have it all in one place. And if you don't want it for yourself, surely it would make a good gift for your favorite budding or would-be writer. After all, Christmas is coming soon! ■

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brass tacks

Dear Mr. Schmidt:

First, congratulations, albeit belated on *Analog*'s sixtieth year. Best wishes for many more.

Your mid-December edition was up to your usual standard of excellence. I count Maya Kaathryn Bohnhoff as one of my favorites, hopefully for decades to come. I hope to see some novels from her word processor on the stands soon. Her concept of the adventures of an executive/cultural anthropologist is exciting. Having known men who have done business in the far-flung corners, it is not that far off the mark for us even before we leave our planet.

Of special interest was Dr. Vuille's article on using the shuttle for a lunar service vehicle. I have taught and occasionally teach space science classes. Is there a typographical error in the units for G?

My literature indicates that the universal gravitational constant is about $6.67 \times 10^{-11} Nm^2/kg^2$. "N" being a Newton or kilogram meter second squared. Is it possible that is what is meant by "$kg^{-1} = m^3\text{-}s^{-2}$?

Due to the italics used, I can not determine if Dr. Vuille refers to a "1" or an "I" in equations 3 and 4. All other terms are defined, so I hope that it is "1."

All in all, this is a classic edition. It will become part of my space science course. Thank you for your continuing standards of excellence in both articles and fiction.

STEVEN LOPATA

Ridgecrest, CA

The "1" in Dr. Vuille's Eqs. 3 and 4 is indeed a one; I agree that it's unclear in that typeface, and I wish we'd noticed that sooner.

There are indeed a couple of typos in the units (and we're still puzzled as to how they got there), though they may

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not be quite the ones you might think. If you drop the extraneous = and – that somehow crept in, so it reads

$$kg^{-1}m^3s^{-2},$$

then it's right. So is the form that you mention: they're equivalent since

$$1\ N = 1\ kg\ m\ sec^{-2}.$$

(Please note that minus sign on the last exponent; it's per *second squared, not* times *second squared.)*

Dear Mr. Schmidt,

The article "Taking the Shuttle to the Moon" by Dr. Vuille (Mid-December 1990) was very enjoyable. More thought and effort needs to be put into innovative approaches to these sorts of problems, and I applaud Dr. Vuille's attempt.

However, there were a few technical errors in the article. None of them are show stoppers, but in the interest of presenting a more accurate mission analysis, the following corrections must be made:

1. A value for the exhaust velocity of a LOx/Hydrogen engine is given as 4,000 m/s. In fact, the Isp (specific impulse) of the SSME's (Space Shuttle Main Engines) is 460 seconds. This translates into an exhaust victory of 4,508 m/s. Using the correct exhaust velocity reduces the required propellant from 162,478 kg to 137,323 kg, a savings of over 25 metric tons.

2. Just keeping the current shuttle ET (External Tank) attached is not a good idea. The ET is much heavier than it needs to be just to hold the fuel and propellant. The ET also serves as the strongback of the shuttle assembly, and is heavily reinforced. All that extra metal becomes dead weight for the lunar mission.

An LMET (Lunar Mission External Tank) would definitely be a good idea. Sizing this tank takes some iteration, because the more fuel required, the heavier the tank, and the heavier the tank, the more fuel required. But, assuming a tankage fraction (tank mass/propellant mass) of 20% for the hydrogen and 5% for the LOx, the LMET would mass 7,873 kg.

Using this value for the LMET, the total propellant comes down to 110,224 kg, a further savings of 27 metric tons!

3. Now comes the bad news. In the article, Dr. Vuille doesn't consider the delta-v's required to get into and out of lunar orbit. He does mention them briefly, but dismisses them as negligible. This turns out not to be the case.

Given the type of trajectory described in the article, the shuttle's velocity at apogee would be about 190 m/s. The Moon's orbital velocity is about 1 km/s, so from the Moon's point of view, the shuttle is approaching at 810 m/s. With this hyperbolic approach velocity, the delta-v required to enter a 50 km altitude circular orbit is 824 m/s.

Remember also that this velocity change must be applied both to enter this orbit and to leave to return to Earth. Thus, the total mission delta-v is 4,731 m/s.

Using this number and resizing the LMET accordingly, the total propellant required becomes 207,252 kg. The empty mass of the LMET is 14,804 kg.

If a highly elliptical lunar orbit is used, the delta-v required of the shuttle could be reduced, but that would just put more of a burden on the lunar lander.

Thus, the mission is somewhat more difficult than originally described, but still quite possible. The required 207 tons of propellant is slightly more than envisioned for the payload capacity of the Shuttle-C, but a reduction in the lunar payload could solve that problem. If certain shuttles were dedicated to lunar

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missions and never returned to Earth, as suggested in the article, then plenty of mass could be saved by removing the now unnecessary wings and tail fin.

Rather than depend on Shuttle-C, I think 10 or 11 Titan IV launches is the better option. It would be nice if we had Shuttle-C, but it it would also be nice if we had nuclear pulse rockets. Given our current budget situation, either one has an equal probability of being developed.

The total cost of 11 Titan IV launches would be about $1.4 billion. The price of a shuttle launch keeps changing, but is currently about $250 million. The only R&D costs are developing the LMET and the lunar lander. Once past the R&D costs, it looks like we could launch one or two lunar missions per year for less than $2 billion.

It's a great idea. A very innovative and comparatively inexpensive use of existing technology. That, of course, is exactly why it'll never happen.

KELLY PARKS
Tucson, AZ

Dear Mr. Schmidt:

This is referring to the article in your Mid-December 1990 issue of *Analog*. I found "Taking the Shuttle to the Moon" by Dr. Chris Vuille, interesting and one of the best articles to appear in a long time. Just think, with some modifications, we could send a space shuttle to the Moon.

Using my calculator, I made some figures for myself. Your article was a bit too complicated with the math for me to understand completely, so I used ideas from the likes of Arthur C. Clarke that came from his books *Interplanetary Flight* and others. Here's my idea of how a shuttle flight would look.

The shuttle is already orbiting the Earth at an altitude of 400 kilometers with a velocity of 7,673 meters per second. Multiplying this figure by the square root of 2 (1.414) would give a figure of 10,851 meters per second. At 99% of this, a vessel can reach the Moon. The shuttle, already in orbit, would need only an additional 2,800 meters per second in order to achieve 99% escape speed (10,473 meters per second).

The shuttle would have to expend enough fuel for 693 meters per second in order to back into lunar orbit. At the end of the visit it would need the same amount of fuel in order to break out of lunar orbit for the return to Earth. Reentry into the Earth's atmosphere, even though begun at a speed of 40,000 kilometers per hour, could be done with atmospheric braking.

So the fuel requirements would look like this:

Maneuver	Velocity (meters per second)
Escape from Earth orbit to the Moon	2,800
Insertion into Lunar orbit	693
Breakaway from Lunar orbit	693
Course corrections	500
Total	4,686

Using a fuel with an exhaust velocity of 4,000 meters per second, a shuttle assembly with a fuel-mass ratio of 3.23 would be required. This means that the shuttle, its tanks, and rockets would have to be 3.23 times heavier fully fueled than empty.

Such a trip would (according to Clarke and others) take 116 hours, or five days.

Suppose such a trip were possible in

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the near future. The first one, of course, wouldn't have a Lunar Module. The shuttle, with its large tank attached, lofts itself into the 400-kilometer orbit. The tank still being attached, the shuttle astronauts refuel the tank and fire the main rocket motor to achieve the extra speed needed for the lunar voyage. After a five-day coast, the shuttle's engines fire again, this time backing the shuttle into lunar orbit. After several orbits, the shuttle's engines fire for the last time, firing the shuttle back to Earth. The shuttle reenters the Earth's atmosphere without any expenditure of fuel.

It's interesting to note that, with articles like this one, space flight and the return to the Moon doesn't seem so far-fetched after all. We can return to the Moon with the technology that we have now.

ARTHUR HAAPOJA, JR.
Mount Prospect, IL

The author replies. . . .

I appreciated the thoughtful analyses detailed in the letters by Kelly Parks and Arthur Haapoja. They are certainly correct that additional delta vee maneuvers would be required to complete the mission. In fact, a thorough analysis of the problem would require a numerical integration, taking into account the influences of the Moon and Sun and other factors, such as deviations from sphericity of both the Earth and the Moon and the fact that the parking orbits are neither truly circular nor equatorial. Engine efficiency under various conditions may also have to be considered, and drag effects in LEO during the rendezvous and refueling operation. Errors in cutoff velocity in the range of a few centimeters per second can result in significant alterations in the transfer ellipse. My intention in writing the article, however, was not to provide a definitive treatment of the problem, but just a ballpark estimate of basic feasibility. The back-of-the-envelope calculation for the trip out (yes, I did use a stray envelope or two) was certainly sufficient for this purpose. I used the 4,000 meter per second exhaust velocity (instead of 4,500) in order to get a fat number that would take care of some of the additional requirements of course correction and braking into lunar orbit. At the time, the result I obtained seemed good enough to make further analysis unnecessary, and I was pleased to find that the additional work of Parks and Haapoja confirmed my intuition.

CHRIS VUILLE, PH.D.

RE: "Ben Franklin's Laser," by Doug Beason in the Mid-December 1990 issue, pp 68-88; quote from p 82; ". . . the magnetic field diffusing past my 'skin' depth."

Dear Mr. Schmidt:

The referenced story prompts several comments. First, it might seem that Mr. Beason has read T. S. Kuhn's book "The Structure of Scientific Revolution" (2nd ed., University of Chicago Press, 1970; particularly pp 13-21) for the history of electrical research in the eighteenth century and Benjamin Franklin's contribution.

Second the idea of modeling the human body as an ohmic conductor is rather common with some biophysicists. However there are reasons why it may not be a good idea. The biologist Barry Commoner has been saying for years that there is something not quite right with studying living organisms by the theory and techniques of physics. Also, the electromagnetic constitutive relations for the human body are scarcely homogeneous and isotropic as are those for an ohmic conductor.

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Mr. Beason has the fictitious character switching "on" a magnetostatic field and then wondering what is the electromagnetic field in his body. To determine the classical field in an ohmic conductor it is necessary to specify the geometry of both the conductor and the source of the field, as well as the time dependence of the source. There is no skin effect in a conductor due to a stationary "DC" field. However, if the time dependence is "AC," i.e. the field is in a steady-state and oscillating with sinusoidal time dependence at constant frequency, then there is indeed a skin effect by which the field may be concentrated at the surface.

But in the example suggested by Beason, the field is the sum of a time-varying, nonsinusoidal transient field plus a stationary steady-state field, equal to that of the magnetostatic source field. The determination of the transient field pulse is quite sensitive to the geometry of source and conductor, as well as the details of the switch, and it might have been wiser to have made test measurements of the field in representative configurations before employing the device. Further, an experimental program would have been more in keeping with the scientific paradigm with which Franklin is associated by Kuhn.

JOHN J. O'GRADY

Oak Parks, IL

The author replies. . . .

Dear Stan:

Mr. O'Grady brings up several interesting points. The idea, and subsequent research, for my novelette "Ben Franklin's Laser" actually occurred during a laser physics course I took in graduate school. (And to think what an off-hand comment by a professor can turn into!)

As much as I'd like to delve into the fascinating field of biophysics and the interactions of the E&M field with organic matter, I'm afraid Mr. O'Grady missed the point of that sentence in "Ben Franklin's Laser." My protagonist, Grayson, simply wondered what would be the effect of switching on a gigagauss magnetic field so close to a human body (since initially the phenomenon would not be steady and would indeed be transient). Grayson was in no position to wonder any further what might happen: faced with an intense deadline between getting his Free Electron Laser to work, and being yanked back to the future, he didn't have enough time to do anything else.

However, given enough time, he *might* have been able to come up with time-varying (localized) permeability and dielectric tensors to help describe these transient effects. There are several sophisticated computer codes — known as "Maxwell solvers" in the genre—that attack similar nonhomogeneous and nonisotropic problems today.

DOUG BEASON ■

●History is useless if one does not look at it in the light of current misfortunes.

Jules Michelet

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a calendar of analog upcoming events

31 October-3 November
WORLD FANTASY CONVENTION at Doubletree Hotel at Randolph Park, Tucson, Ariz. Guests—Harlan Ellison, Susan Ellison, Stephen R. Donaldson, Arlin Robins. Registration—$80 until 15 October, no at-the-door memberships, $25 banquet. Info: 1991 World Fantasy Convention, Box 27201, Tempe AZ 85285.

8-10 November
ORYCON 13 (Portland area SF conference) at Red Lion/Columbia River, Portland, Ore. Guests of Honor—Emma Bull & Will Shetterly. Registration—$20 until 31 October, $25 at the door. Info: OryCon 13, Box 7503, Portland OR 97228, (503)693-1739.

8-10 November
Sci-Con 13 (Tidewater area SF conference) at Holiday Inn Executive Center, Virginia Beach, Va. Guest of Honor—Lois McMaster Bujold, Artist Guest of Honor—Vincent Di-Fate. Registration—$20 in advance, $25 at the door. Info: Sci-Con Box 9434, Hampton VA 23670.

8-10 November
WINDYCON XVIII (Chicago area SF conference) at Hyatt Regency Woodfield, Woodfield, Ill. Author Guest of Honor—Mike Resnick, Artist Guest of Honor—P. D. Breeding-Black, Editor Guest of Honor—Robert Weinberg, Fan Guest of Honor—Howard DeVore, TM—George Alec Effinger. Registration—$20 until 30 September, $30 at the door. Info: Windycon, Box 432, Chicago IL 60690.

15-17 November
PHILCON '91 (55th Philadelphia regional SF conference) at the Adam's Mark Hotel, Philadelphia, Pa. Principal Speaker—David Brin, Guest Artist—Moebius (Jean Giraud). Registration $15 until 18 November. Info: Philadelphia SF Society, Box 8303, Philadelphia PA 19101.

22-24 November
SOONERCON 7 (Oklahoma area SF conference) at Central Plaza Hotel, Oklahoma City, Okla. Guest of Honor—Tim Powers, Artist Guest of Honor—Patricia Davis, Fan Guests of Honor—Curtis and Marilyn Berry, Filk Guest of Honor—Marty Burke, TM—Mike McQuay. Registration—$13 until 1 November, $20+ + at the door. Info: SoonerCon 7, Box 1701, Bethany OK 73008. (405)769-4417.

29 November-1 December
LOSCON 18 (Los Angeles area SF conference). Info: LASFS, Inc., 11513 Burbank Blvd., North Hollywood CA 91601. (818)760-9234.

3-7 September 1992
MAGICON (50th World Science Fiction Convention) at Orange County Civic & Convention Center, Orlando, Fla. Guest of Honor—Jack Vance; Artist Guest of Honor — Vincent Di Fate; Fan Guest of Honor — Walter A. Willis. Registration — $85 adult/$35 child until 30 September, Supporting—$25. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: MagiCon, Box 621992, Orlando FL 32862-1992. (407)275-0027. UK agent Peter Weston, 72 Beeches Drive, Erdington, Birmingham B24 ODT UK.

—Anthony Lewis

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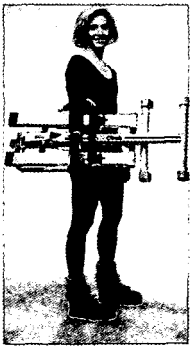

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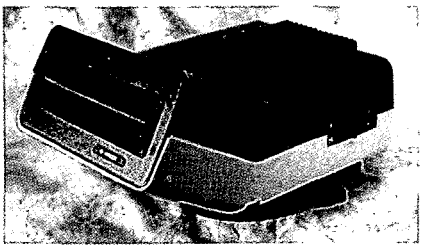

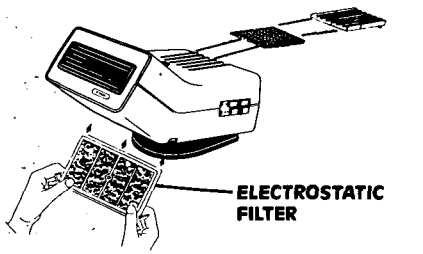

▼ SLEEP SOUNDLY WITH SOUND SLEEPER

Is noise pollution interfering with your ability to get a good night's sleep? If so, then the Sound Sleeper by Audiologic is the clock radio of your dreams. Sound Sleeper combines a state of the art AM/FM cassette clock radio with the benefits of natural sound conditioning. Sound Sleeper lets you fall asleep to the sounds of ocean surf, rushing waterfalls and/or rainfall with the flip of a switch. After a relaxing night's sleep, wake up with a buzzer or music from the radio or cassette. So why have an ordinary clock radio when you can have the cassette clock radio that not only wakes you up but also lulls you to sleep! **$89.98** ($5.50) #A2000.

TO ORDER: Send check with item number for total amounts, plus shipping & handling shown in ( ) payable to **MAIL ORDER MALL** Dept. 111 AN; P.O. Box 3006, Lakewood, N.J. 08701, or call TOLL FREE **1-800-722-9999**. NJ residents add 7% sales tax. We honor MasterCard, Visa, and American Express. Sorry, no Canadian, foreign, or C.O.D. orders. Satisfaction Guaranteed. 30 day money back guarantee for exchange or refund. Allow 30 days for delivery.

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